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"SUBSTRATE TREATMENT DEVICE"

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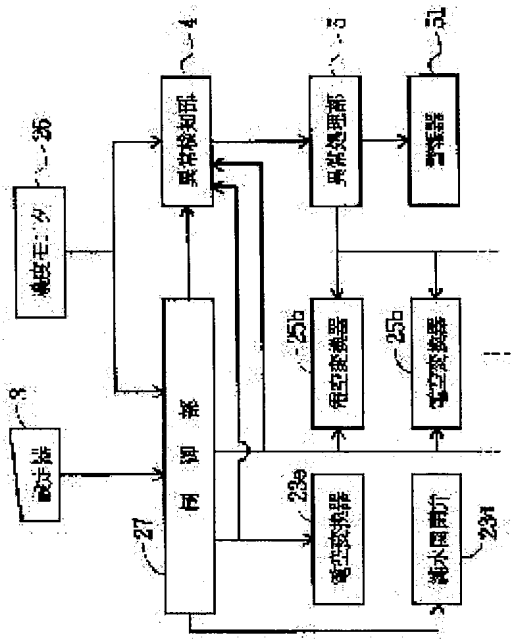
(54) SUBSTRATE TREATMENT DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To restrain the generation of treatment defects by detecting abnormalities such as failures of a part.
SOLUTION: This substrate treatment device has a mixed treatment solution supply part with a function for supplying mixed treatment solution of a concentration desired value to a treatment bath inside a substrate treatment part by controlling a chemical supply flow rate adjustment mechanism with a control part 27 by feed back control, based on the concentration current value of a mixed treatment solution monitored by a concentration monitor 26. When an abnormality detection part 4 detects that a concentration current value of the mixed treatment solution from the concentration monitor 26 is outside the concentration tolerance or a current value of each treatment solution supply flow rate operation signal provided from the control part 27 to electropneumatic converters 23e, 25b is outside each variation tolerance, it decides that abnormality is generated, and an abnormality treatment part 5 completely stops the supply of chemical to a mixing part as abnormality treatment, and pure water alone is supplied to a treatment bath and an alarm is given by making an alarm 51 such as a buzzer and a lamp operate.



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CLAIMS

[Claim(s)]
[Claim 1] The substrate processing section which performs surface treatment of a substrate with the mixed processing liquid which mixed two or more kinds of processing liquid, and was obtained, The mixed section which mixes two or more kinds of processing liquid, and the mixed processing liquid supply system which supplies the mixed processing liquid mixed in said mixed section to said substrate processing section, Two or more processing liquid supply systems which supply each processing liquid to said mixed section according to an individual, A processing liquid supply-flow-rate accommodation means to adjust the supply flow rate of the processing liquid to said mixed section, The control means which gives a processing liquid supply-flow-rate manipulate signal which negates the concentration deflection of a concentration monitor means to supervise the concentration current value of mixed processing liquid, and the concentration desired value of mixed processing liquid and the concentration current value of mixed processing liquid to said processing liquid supply-flow-rate accommodation means, The substrate processor characterized by having an abnormality detection means to detect that abnormalities occurred based on whether the concentration current value of mixed processing liquid separated from the predetermined concentration tolerance of mixed processing liquid, and an exception-processing means to perform predetermined exception processing if an abnormal occurrence is detected.
[Claim 2] It is the substrate processor characterized by supervising further the current value of the processing liquid supply-flow-rate manipulate signal with which said abnormality detection means is given to said processing liquid supply-flow-rate accommodation means from said control means in a substrate processor according to claim 1, also taking into consideration the information on whether the current value of this processing liquid supply-flow-rate manipulate signal separated from the predetermined fluctuation tolerance of a processing liquid supply-flow-rate manipulate signal, and judging an abnormal occurrence.
[Claim 3] Exception processing which said exception-processing means performs in a substrate processor according to claim 1 or 2 is a substrate processor characterized by including the processing which suspends supply of some [at least] processing liquid to said mixed section.
[Claim 4] It is the substrate processor characterized by equipping said substrate processing section with the processing tub which is immersed in mixed processing liquid in two or more substrates, and performs surface treatment of each substrate in the substrate processor according to claim 1 or 2, for two or more kinds of processing liquid supplied to said mixed section being pure water and one or more kinds of drug solutions, for said exception-processing means suspending supply of a drug solution if an abnormal occurrence is detected, and supplying only pure water.
[Claim 5] Exception processing which said exception-processing means performs in a substrate processor according to claim 1 to 4 is a substrate processor characterized by including the processing which emits an alarm.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is the mixed processing liquid which mixed two or more kinds of processing liquid, and was obtained, and relates to the substrate processor of single wafer processing which performs surface preparation of substrates, such as a glass substrate for a semi-conductor wafer or liquid crystal displays, a glass substrate for photo masks, and a substrate for optical disks, or a batch type.
[0002]
[Description of the Prior Art] This conventional kind of substrate processor is equipped with the substrate processing section which performs surface treatment of a substrate with the mixed processing liquid which mixed two or more kinds of processing liquid, and was obtained, and the mixed processing liquid feed zone which mixes two or more kinds of processing liquid, and supplies the obtained mixed processing liquid to the substrate processing section.
[0003] A mixed processing liquid feed zone For example, the mixed section which mixes two or more kinds of processing liquid, The mixed processing liquid supply system which supplies the mixed processing liquid mixed in the mixed section to the substrate processing section, Two or more processing liquid supply systems which supply each processing liquid according to an individual at the mixed section, and the processing liquid supply-flow-rate regulatory mechanism which adjusts the supply flow rate of the processing liquid to the mixed section according to the given processing liquid supply-flow-rate manipulate signal, It has the control section which gives a processing liquid supply-flow-rate manipulate signal which negates the concentration deflection of the concentration surveillance which supervises the concentration current value of mixed processing liquid, and the concentration desired value of mixed processing liquid and the concentration current value of mixed processing liquid to a processing liquid supply-flow-rate regulatory mechanism. It has the function which a control section controls a processing liquid supply-flow-rate regulatory mechanism by feedback control based on the concentration current value of the mixed processing liquid supervised in concentration surveillance, and supplies the mixed processing liquid of concentration desired value to the substrate processing section.
[0004]
[Problem(s) to be Solved by the Invention] However, as mentioned above, in the case of the substrate processor equipped with the mixed processing liquid feed zone which mixes mixed processing liquid by feedback control, there are the following problems.
[0005] A processing liquid supply-flow-rate regulatory mechanism consists of a pressure controller, a flow control valve, a pump, etc. namely, concentration surveillance For example, the concentration monitor which obtains the concentration of mixed processing liquid based on the reinforcement of the transmitted light to mixed processing liquid after being mixed in the mixed section, Or although it consists of devices which supervise the current value of the supply flow rate of each processing liquid to the mixed section, and compute and supervise the concentration current value of mixed processing liquid from the current value of the supply flow rate of each [these] processing liquid and the control section consists of microcomputers equipped with CPU, memory, etc. If at least one failure of these components etc. breaks out, the

situation where it becomes impossible to be stabilized, and for it to become impossible to supply the mixed processing liquid as concentration desired value to the substrate processing section, and to perform surface treatment of a substrate proper may arise.
[0006] The concentration current value of the mixed processing liquid recognized by the control section may stop for example, being in agreement with the actual concentration of mixed processing liquid with failure of concentration surveillance. In this case, feedback control will be carried out so that a control section may obtain the mixed processing liquid of concentration desired value based on the actual concentration of mixed processing liquid, and different concentration. Therefore, when recognizing it as the mixed processing liquid of concentration desired value being obtained by the control section, the mixed processing liquid which is different from concentration desired value will be mixed actually, and the substrate processing section will be supplied.
[0007] Moreover, for example, the value of the processing liquid supply-flow-rate manipulate signal given to a processing liquid supply-flow-rate regulatory mechanism from a control section may shift from the desired value of the manipulate signal corresponding to concentration desired value greatly by failure and malfunction of a control section. In this case, the feedback control by the control section is not stabilized, but the concentration of the mixed processing liquid obtained oscillates, and the mixed processing liquid of concentration desired value is stabilized, and is no longer obtained.
[0008] Moreover, by failure of a processing liquid supply-flow-rate regulatory mechanism, also when performing accommodation of the supply flow rate of the processing liquid according to the processing liquid supply-flow-rate manipulate signal given from a control section, and different accommodation, the feedback control by the control section is not stabilized, but the concentration of the mixed processing liquid obtained oscillates, and the mixed processing liquid of concentration desired value is stabilized, and is no longer obtained.
[0009] Even if the components in mixed processing liquid feed zones other than concentration surveillance, or a control section and a processing liquid supply-flow-rate regulatory mechanism break down, it is stabilized and it may become impossible in addition, to supply the mixed processing liquid as concentration desired value to the substrate processing section.
[0010] However, conventionally, failure of the components in a mixed processing liquid feed zone etc. is not supervised, but an operator has come to get to know that abnormalities occurred in the mixed processing liquid feed zone only after poor processing of a substrate occurred. Therefore, when the components in a mixed processing liquid feed zone break down conventionally, generating of poor processing of a substrate is not avoided but there is a problem of causing lowering of the dependability to equipment. Moreover, if the substrate of poor processing is continued and it continues manufacturing, it will become things, and there is also a possibility of manufacturing many substrates of poor processing until an operator gets to know that poor processing of a substrate occurred. Furthermore, as a result of poor processing, depending on substrate processing, unrecoverable breakage may have to be done to a substrate, a substrate may have to be discarded, and, in such a case, a user will suffer great damage. When poor processing of many substrates occurs at a time and a substrate must be discarded as a result of poor processing if abnormalities occur in a mixed processing liquid feed zone since especially the substrate processor of a batch type packs two or more substrates, is immersed in mixed processing liquid and processed, the amount of damage will become huge.
[0011] This invention is made in view of such a situation, detects abnormal occurrences, such as failure of components, controls generating of poor processing of a substrate, and aims at offering a reliable substrate processor.
[0012]
[Means for Solving the Problem] This invention takes the following configurations, in order to attain such an object. Namely, the substrate processing section which performs surface treatment of a substrate with the mixed processing liquid which invention according to claim 1 mixed two or more kinds of processing liquid, and was obtained, The mixed section which mixes two or more kinds of processing liquid, and the mixed processing liquid supply system which supplies the mixed processing liquid mixed in said mixed section to said substrate processing

section, Two or more processing liquid supply systems which supply each processing liquid to said mixed section according to an individual, A processing liquid supply-flow-rate accommodation means to adjust the supply flow rate of the processing liquid to said mixed section, The control means which gives a processing liquid supply-flow-rate manipulate signal which negates the concentration deflection of a concentration monitor means to supervise the concentration current value of mixed processing liquid, and the concentration desired value of mixed processing liquid and the concentration current value of mixed processing liquid to said processing liquid supply-flow-rate accommodation means, It is characterized by having an abnormality detection means to detect that abnormalities occurred based on whether the concentration current value of mixed processing liquid separated from the predetermined concentration tolerance of mixed processing liquid, and an exception-processing means to perform predetermined exception processing if an abnormal occurrence is detected.

[0013] It is characterized by also taking into consideration the information on whether in the substrate processor given in above-mentioned claim 1, said abnormality detection means supervised further the current value of the processing liquid supply-flow-rate manipulate signal given to said processing liquid supply-flow-rate accommodation means from said control means, and the current value of this processing liquid supply-flow-rate manipulate signal separated from invention according to claim 2 from the predetermined fluctuation tolerance of a processing liquid supply-flow-rate manipulate signal, and judging an abnormal occurrence.

[0014] Exception processing to which said exception-processing means performs invention according to claim 3 to above-mentioned claims 1 or 2 in the substrate processor of a publication is characterized by including the processing which suspends supply of some [at least] processing liquid to said mixed section.

[0015] Invention according to claim 4 is set to a substrate processor given in above-mentioned claims 1 or 2. Said substrate processing section Two or more kinds of processing liquid which is equipped with the processing tub which is immersed in mixed processing liquid in two or more substrates, and performs surface treatment of each substrate, and is supplied to said mixed section It is pure water and one or more kinds of drug solutions, and said exception-processing means will suspend supply of a drug solution, if an abnormal occurrence is detected, and it is characterized by supplying only pure water.

[0016] Exception processing to which said exception-processing means carries out invention according to claim 5 in above-mentioned claim 1 thru/or a substrate processor given in either of 4 is characterized by including the processing which emits an alarm.

[0017]

[Function] The operation of invention according to claim 1 is as follows. Two or more kinds of processing liquid is mixed as follows, and the obtained mixed processing liquid is supplied to the substrate processing section.

[0018] That is, two or more kinds of processing liquid is supplied to the mixed section from two or more processing liquid supply systems, each processing liquid is mixed in the mixed section, and mixed processing liquid is obtained. This mixed processing liquid is supplied to the substrate processing section by the mixed processing liquid supply system, and surface treatment of a substrate is performed by this mixed processing liquid in the substrate processing section.

[0019] The supply flow rate of the processing liquid to the mixed section is adjusted by the processing liquid supply-flow-rate accommodation means according to the processing liquid supply-flow-rate manipulate signal given from the control means.

[0020] Moreover, the concentration monitor means is supervising the concentration current value of mixed processing liquid, and a control means gives a processing liquid supply-flow-rate manipulate signal which negates the concentration deflection of the concentration desired value of mixed processing liquid, and the concentration current value of mixed processing liquid to a processing liquid supply-flow-rate accommodation means, and mixes mixed processing liquid by feedback control.

[0021] In the equipment of the above-mentioned configuration, if components, such as a concentration monitor means, and a control means, a processing liquid supply-flow-rate accommodation means, break down, the concentration current value of mixed processing liquid

may shift from concentration desired value, or concentration may oscillate and it may become instability. Therefore, focusing on the concentration desired value of mixed processing liquid, a proper concentration upper limit and a concentration lower limit can be set up, and generating of abnormalities, such as failure of components, can be detected by whether it is being completed by the concentration current value of mixed processing liquid into the concentration tolerance, or it separated from concentration tolerance by making concentration width of face in the meantime into concentration tolerance.

[0022] Then, if it detects that abnormalities generated the abnormality detection means based on whether the concentration current value of the mixed processing liquid from a concentration monitor means separated from the predetermined concentration tolerance of mixed processing liquid and an abnormal occurrence is detected by the abnormality detection means, an exception-processing means will perform predetermined exception processing like invention of a publication to claim 3 thru/or 5.

[0023] In invention according to claim 2, an abnormality detection means supervises further the current value of the processing liquid supply-flow-rate manipulate signal given to a processing liquid supply-flow-rate accommodation means from a control means, and the current value of this processing liquid supply-flow-rate manipulate signal also takes into consideration the information on whether it separated from the predetermined fluctuation tolerance of a processing liquid supply-flow-rate manipulate signal, and judges an abnormal occurrence. If abnormalities, such as failure of components, such as a concentration monitor means, occur, it may shift from the desired value of the processing liquid supply-flow-rate manipulate signal corresponding to the concentration desired value of mixed processing liquid greatly, or the processing liquid supply-flow-rate manipulate signal given to a processing liquid supply-flow-rate accommodation means from a control means may oscillate, and may become instability. Therefore, the current value of the processing liquid supply-flow-rate manipulate signal to which manipulate signal width of face in the meantime is given by the processing liquid supply-flow-rate accommodation means from fluctuation tolerance, then a control means by setting up a proper manipulate signal upper limit and a manipulate signal lower limit focusing on the desired value of the processing liquid supply-flow-rate manipulate signal corresponding to the concentration desired value of mixed processing liquid can also use the information on whether it separated from the predetermined fluctuation tolerance of a processing liquid supply-flow-rate manipulate signal for the judgment of an abnormal occurrence. According to this invention according to claim 2, a processing liquid supply-flow-rate manipulate signal can also be taken into consideration, and generating of abnormalities, such as failure of components, can be detected more certainly.

[0024] According to invention according to claim 3, if an abnormal occurrence is detected by the abnormality detection means, an exception-processing means will suspend supply of some [at least] processing liquid to the mixed section as exception processing. An exception-processing means may suspend supply of all the processing liquid to the mixed section according to an equipment configuration, a situation of operation, etc., for example like invention according to claim 4, supply in the mixed section of the processing liquid which has trouble in a substrate may be suspended, and supply in the mixed section of the processing liquid which does not have trouble in a substrate may be continued.

[0025] Invention according to claim 4 is the substrate processor of the batch type which equipped the substrate processing section with the processing tub which is immersed in mixed processing liquid in two or more substrates, and performs surface preparation of each substrate. It is exception processing in case two or more kinds of processing liquid supplied to the mixed section is pure water and one or more kinds of drug solutions, and an exception-processing means will suspend supply of the drug solution which is the processing liquid which has trouble in a substrate, if an abnormal occurrence is detected by the abnormality detection means, and it supplies only the pure water which is the processing liquid which does not have trouble in a substrate.

[0026] According to invention according to claim 5, an exception-processing means will emit an alarm, if an abnormal occurrence is detected by the abnormality detection means.

[0027]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing 1 is drawing showing the whole substrate processor configuration concerning the 1st example of this invention, and drawing 2 is the block diagram showing the configuration of the control system.
[0028] This 1st example equipment is one example of the substrate processor of the batch type which performs surface preparation of Substrate W with the mixed processing liquid which mixed the pure water as two or more kinds of processing liquid, and one or more kinds of drug solutions, and was obtained.
[0029] The substrate processing section 1 equipped with the processing tub 10 which roughly divides this equipment, is immersed in mixed processing liquid in two or more substrates W, and performs surface treatment of each substrate W, It has the mixed processing liquid feed zone 2 which mixes pure water and a drug solution and supplies the obtained mixed processing liquid to the processing tub 10 in the substrate processing section 1, the setter 3 which sets up the mixed conditions which determine the concentration desired value of mixed processing liquid, and the abnormality detection section 4 and the exception-processing section 5.
[0030] The processing tub 10 receives supply of mixed processing liquid from the bottom of the tank section, and it is constituted so that excessive mixed processing liquid may be made to overflow and it may be made to discharge. The mixed processing liquid discharged from the processing tub 10 may be constituted so that it may discard, and it returns to the mixed processing liquid feed zone 2, and you may make it reuse it.
[0031] The mixed section 21 in which the mixed processing liquid feed zone 2 mixes each drug solution with pure water, and the mixed processing liquid supply system 22 which supplies the mixed processing liquid mixed in the mixed section 21 to the processing tub 10 in the substrate processing section 1, The pure-water supply system 23 which supplies pure water to the mixed section 21, and 1 or two or more drug solution supply systems 24 which supply each drug solution to the mixed section 21 according to an individual, Pure-water supply-flow-rate regulatory mechanism 25P which adjust the supply flow rate of the pure water to the mixed section 21 according to the given pure-water supply-flow-rate manipulate signal (processing liquid supply-flow-rate manipulate signal), Drug solution supply-flow-rate regulatory mechanism 25Q which adjusts the supply flow rate of each drug solution to the mixed section 21 according to the given drug solution supply-flow-rate manipulate signal (processing liquid supply-flow-rate manipulate signal), It has the control section 27 which gives a drug solution supply-flow-rate manipulate signal which negates the concentration deflection of the concentration monitor 26 for supervising the concentration current value of mixed processing liquid, and the concentration desired value of mixed processing liquid and the concentration current value of mixed processing liquid to drug solution supply-flow-rate regulatory mechanism 25Q. This control section 27 has the function which controls drug solution supply-flow-rate regulatory mechanism 25Q by feedback control based on the concentration current value of the mixed processing liquid supervised with the concentration monitor 26, and supplies the mixed processing liquid of concentration desired value to the processing tub 10 in the substrate processing section 1.
[0032] The mixed section 21 is equipped with mixer tube 21c in which pure-water passage 21a and each drug solution installation way 21b which introduces each drug solution into pure-water passage 21a were formed. It is constituted so that each drug solution may be introduced into the pure water which is circulating to pure-water passage 21a from each drug solution installation way 21b, pure water and a drug solution may be mixed and mixed processing liquid may be discharged from 21d of outlets of pure-water passage 21a. 21d of outlets of pure-water passage 21a -- for example, a hole -- proper agitator styles, such as a static mixer which consists of an empty torsion plate etc., may be arranged, and you may constitute so that pure water and each drug solution can be mixed without nonuniformity.
[0033] Free passage connection of the end side was made at 21d of outlets of pure-water passage 21a of mixer tube 21c which constitutes the mixed section 21, and the mixed processing liquid supply system 22 equips the pars basilaris ossis occipitalis of the processing tub 10 with mixed processing liquid supply pipe 22a by which free passage connection of the other end side

was made. The concentration monitor 26 is arranged in the middle of the duct of this mixed processing liquid supply pipe 22a. This concentration monitor 26 can measure the concentration of mixed processing liquid, i.e., the concentration of the drug solution in mixed processing liquid, based on the reinforcement of the transmitted light to mixed processing liquid after being mixed in the mixed section 21, or the reflected light. In addition, this kind of concentration monitor 26 can obtain the concentration of each drug solution in mixed processing liquid according to an individual, even when the spectral characteristic of each drug solution was different and two or more kinds of drug solutions are mixed to pure water.

[0034] Free passage connection of the end side was made at pure-water supply source 23a, and the other end side equips inlet-port 21e of pure-water passage 21a of mixer tube 21c which constitutes the mixed section 21 with pure-water supply pipe 23b by which free passage connection was made at the pure-water supply system 23. Pure-water pressure controller 23c and 23d of pure-water closing motion valves are arranged in pure-water supply pipe 23b sequentially from the pure-water supply source 23a side. According to the pneumatic pressure (pilot pressure) given from electro-pneumatic-converter 23e, pure-water pressure controller 23c is a control valve which adjusts the secondary pure-water pressure of pure-water pressure controller 23c, can fix the flow rate of the pure water which circulates secondary pure-water supply way 23b of pure-water pressure controller 23c by this pure-water pressure controller 23c, and can make regularity the supply flow rate of the pure water supplied to the mixed section 21.

[0035] Electro-pneumatic-converter 23e changes and outputs the application-of-pressure air (compressed air) supplied to the pneumatic pressure (pilot pressure) according to the actuation electrical potential difference (pure-water supply-flow-rate manipulate signal) from a control section 27. When a control section 27 gives an actuation electrical potential difference which serves as pure-water supply-flow-rate desired value which the supply flow rate of the pure water supplied to the mixed section 21 mentions later to electro-pneumatic-converter 23e, the pure water of pure-water flow rate desired value is supplied to the mixed section 21. Pure-water pressure controller 23c and electro-pneumatic-converter 23e constitute pure-water supply-flow-rate regulatory mechanism 25P.

[0036] 23d of pure-water closing motion valves is the closing motion valve which switches supply and its halt of the pure water to the mixed section 21, and the closing motion control is performed by the control section 27.

[0037] Since all the configurations of each drug solution supply system 24 are the same, the configuration of one drug solution supply system 24 is explained to an example. Free passage connection of the end side was made at drug solution supply source 24a, and the drug solution supply system 24 equips drug solution installation way 21b of mixer tube 21c which constitutes the mixed section 21 with drug solution supply pipe 24b by which free passage connection of the other end side was made. Drug solution flow-control-valve 25a is arranged in drug solution supply pipe 24b.

[0038] Drug solution supply-flow-rate regulatory mechanism 25Q is equipped with the above-mentioned drug solution flow-control-valve 25a and electro-pneumatic-converter 25b. By giving pilot pressure to drug solution flow-control-valve 25a from electro-pneumatic-converter 25b, the opening of the valve of drug solution flow-control-valve 25a can be operated, the drug solution flow rate of drug solution supply pipe 24b can be controlled, and the supply flow rate of the drug solution to the mixed section 21 can be adjusted. In addition, drug solution flow-control-valve 25a is making the closing motion valve serve a double purpose, it can also adjust it so that a valve may be closed thoroughly, and it can also suspend supply of the drug solution to the mixed section 21 by closing a valve thoroughly.

[0039] The mixed conditions set up from the setter 3 are given to a control section 27. From a setter 3, the concentration desired value (concentration desired value of each drug solution in mixed processing liquid) of mixed processing liquid, pure-water supply-flow-rate desired value, all the drug solution supply-flow-rate desired value, or any two desired value are set up as mixed conditions. When any two desired value is set up, the one remaining desired value can be computed from the two desired value. Therefore, in a control section 27, the concentration

desired value of mixed processing liquid, pure-water supply-flow-rate desired value, and all the drug solution supply-flow-rate desired value can be grasped. Then, a control section 27 gives an actuation electrical potential difference (drug solution supply-flow-rate manipulate signal) which negates the concentration deflection of the concentration desired value of mixed processing liquid, and the concentration current value of the mixed processing liquid supervised with the concentration monitor 26 to electro-pneumatic-converter 25b while giving an actuation electrical potential difference (pure-water supply-flow-rate manipulate signal) which maintains the supply flow rate of the pure water supplied to the mixed section 21 to pure-water supply-flow-rate desired value to electro-pneumatic-converter 23e, as mentioned above.

[0040] namely, when the concentration current value of the mixed processing liquid from the concentration monitor 26 is smaller than the concentration desired value of mixed processing liquid An actuation electrical potential difference which increases the supply flow rate of the drug solution to the mixed section 21 is given to electro-pneumatic-converter 25b. When the concentration current value of the mixed processing liquid from the concentration monitor 26 is larger than the concentration desired value of mixed processing liquid, an actuation electrical potential difference which reduces the supply flow rate of the drug solution to the mixed section 21 is given to electro-pneumatic-converter 25b, and it controls so that concentration deflection is set to "0."

[0041] In addition, the actuation electrical potential difference to electro-pneumatic-converter 25b in the above-mentioned feedback control is computed by the approach of the common knowledge in feedback control based on a control law, pure-water supply-flow-rate desired value, etc. containing P (proportional control action), I (integral control action), I2 (double integral actuation), and D (derivative control action). Moreover, in mixing two or more kinds of drug solutions to pure water, based on the concentration desired value for every drug solution, it performs the above-mentioned control in parallel for every drug solution.

[0042] This control section 27 consists of microcomputers equipped with CPU or memory etc.

[0043] The concentration current value of the mixed processing liquid given to a control section 27 from the concentration monitor 26 and the actuation electrical potential difference (a pure-water supply-flow-rate manipulate signal, drug solution supply-flow-rate manipulate signal) given to electro pneumatic converters 23e and 25b from a control section 27 are given to the abnormality detection section 4. Moreover, the concentration desired value of mixed processing liquid, pure-water supply-flow-rate desired value, and drug solution supply-flow-rate desired value are given to the abnormality detection section 4 from a control section 27. Based on pure-water supply-flow-rate desired value, the desired value of the pure-water supply-flow-rate manipulate signal (actuation electrical potential difference given to electro-pneumatic-converter 23e from a control section 27) corresponding to the concentration desired value of mixed processing liquid can be calculated, and the desired value of the drug solution supply-flow-rate manipulate signal (actuation electrical potential difference given to electro-pneumatic-converter 25b from a control section 27) corresponding to the concentration desired value of mixed processing liquid can be calculated based on drug solution supply-flow-rate desired value.

[0044] If the concentration desired value of mixed processing liquid is DT as shown in drawing 3 , in the abnormality detection section 4, the proper concentration upper limit DU and the concentration lower limit DD will be set up focusing on this concentration desired value DT, and let that concentration width of face be the concentration tolerance DW. The concentration upper limit DU and the concentration lower limit DD are set up by considering as the value which added the constant decided beforehand to the concentration desired value DT, for example, and the subtracted value, or considering as the value which added the value which multiplied the rate decided beforehand by the concentration desired value DT to the concentration desired value DT, and the subtracted value etc. In addition, as shown in drawing 3 (b), when the concentration desired value DT changes with time, the concentration tolerance DW is also changed according to it.

[0045] Moreover, if the desired value of the processing liquid supply-flow-rate manipulate signal (a pure-water supply-flow-rate manipulate signal or a drug solution supply-flow-rate manipulate signal may be used) of a certain processing liquid is CST as shown in drawing 4 , in the

abnormality detection section 4, a core [the desired value CST of this processing liquid supply-flow-rate manipulate signal], the proper manipulate signal upper limit CSU and the manipulate signal lower limit CSD will be set up, and let manipulate signal width of face in the meantime be the fluctuation tolerance CSW. The manipulate signal upper limit CSU and the manipulate signal lower limit CSD are set up by the approach like the concentration upper limit DU and the concentration lower limit DD which were mentioned above, and as shown in drawing 4 (b), when the desired value CST of a processing liquid supply-flow-rate manipulate signal changes with time, they change the fluctuation tolerance CSW according to it. In the abnormality detection section 4, all that are used for mixing of mixed processing liquid also ask for each fluctuation tolerance CSW to processing liquid (pure water and each drug solution).

[0046] And the abnormality detection section 4 judges an abnormal occurrence based on the information on whether the concentration current value of the mixed processing liquid from the concentration monitor 26 separated from the concentration tolerance DW, and the information on whether the current value of each processing liquid supply-flow-rate manipulate signal given to electro pneumatic converters 23e and 25b from a control section 27 separated from each fluctuation tolerance CSW.

[0047] The exception-processing section 5 gives an actuation electrical potential difference which gives the pilot pressure which closes the valve of drug solution flow-control-valve 25a to drug solution flow-control-valve 25a to electro-pneumatic-converter 25b, and suspends all supplies of the drug solution to the mixed section 21, if an abnormal occurrence is detected, while changing into the condition that only pure water is supplied to the processing tub 10, the alarms 51, such as a buzzer and a lamp, will be operated, and exception processing, such as emitting an alarm, is performed.

[0048] The control section 27 consists of microcomputers according to individual etc. for the abnormality detection section 4 and the exception-processing section 5.

[0049] Next, actuation of the equipment which has the above-mentioned configuration is explained. First, an operator sets up mixed conditions from a setter 3. Based on the set-up mixed conditions, a control section 27 prepares processing and the abnormality detection section 4 sets up the concentration tolerance DW and the fluctuation tolerance CSW.

[0050] When starting supply of mixed processing liquid to the processing tub 10, the processing tub 10 is filled with pure water. This is also the same as when the following mixed processing liquid performs surface treatment of Substrate W, after it performs surface treatment of Substrate W using a certain mixed processing liquid. That is, after the surface treatment of the substrate W with a certain mixed processing liquid finishes, only pure water is supplied to the processing tub 10, and pure water once permutes the mixed used processing liquid in the processing tub 10. Following it, by starting installation of the drug solution to the inside of pure water in the condition that pure water is supplied to the processing tub 10, new mixed processing liquid is supplied to the processing tub 10, and new mixed processing liquid permutes the pure water of the processing tub 10.

[0051] While a control section 27 continues giving a pure-water supply-flow-rate manipulate signal which the pure water of pure-water supply-flow-rate desired value according to the concentration desired value of mixed processing liquid supplies to the mixed section 21 uniquely to electro-pneumatic-converter 23e As shown in drawing 5 , between predetermined time ts from supply initiation of a drug solution A drug solution supply-flow-rate manipulate signal which the drug solution of drug solution supply-flow-rate desired value according to the concentration desired value of mixed processing liquid supplies to the mixed section 21 is uniquely given to electro-pneumatic-converter 25b. After predetermined time ts passes since supply initiation of a drug solution, an actuation electrical potential difference which negates the concentration deflection of the concentration desired value of mixed processing liquid and the concentration current value of the mixed processing liquid from the concentration monitor 26 which are decided from the set-up mixed conditions is given to electropneumatic converter 25b. Mixed processing liquid is mixed by feedback control. Since the standup of the drug solution supply flow rate to the mixed section 21 is slow, if concentration deflection becomes large and feedback control is performed at the beginning [of a drug solution] of supply initiation at this time, the

so-called transient overshoot to which the concentration current value of mixed processing liquid becomes high too much will occur. In order to prevent this, he does not perform feedback control between the predetermined time ts of the time of supply initiation of a drug solution, but is trying to give a drug solution supply-flow-rate manipulate signal which the drug solution of drug solution supply-flow-rate desired value according to the concentration desired value of mixed processing liquid supplies to the mixed section 21 uniquely to electro-pneumatic-converter 25b.

[0052] In parallel to it, the abnormality detection section 4 supervises whether each processing liquid supply-flow-rate manipulate signal given to the electropneumatic converters 23e and 25b from whether the concentration current value of the mixed processing liquid from the concentration monitor 26 separated from the concentration tolerance DW and a control section 27 separated from each fluctuation tolerance CSW. In drawing 5 (a), that the concentration current value of mixed processing liquid separated from the concentration tolerance DW, or each processing liquid supply-flow-rate manipulate signal separates from each fluctuation tolerance CSW in drawing 5 (b) can presume failure of the components in the mixed processing liquid feed zone 2 etc. that a certain abnormalities occurred. Therefore, it judges it to be what abnormalities generated when detected that the concentration current value of mixed processing liquid separated from the concentration tolerance DW, or each processing liquid supply-flow-rate manipulate signal separated from each fluctuation tolerance CSW, and the exception-processing section 5 suspends all supplies of the drug solution to the mixed section 21, and while changing into the condition that only pure water is supplied to the processing tub 10, an alarm is emitted from an alarm 51. Thereby, if abnormalities occur, the processing tub 10 is permuted by pure water, is not immersed in the mixed processing liquid which separated from concentration desired value in the long duration substrate W, and can prevent the breakage to Substrate W etc. Moreover, if abnormalities occur with an alarm, an operator can know an abnormal occurrence immediately and can perform a proper rehabilitation work promptly.

[0053] By the way, as shown in drawing 5 at the beginning which began to supply a drug solution to the mixed section 21 from the condition that only the pure water in early stages of supply initiation of mixed processing liquid is supplied to the processing tub 10, the standup of the drug solution supply flow rate to the mixed section 21 is slow, and after proper time amount passes, the concentration current value of mixed processing liquid reaches concentration desired value. Therefore, by the initial stage of supply initiation of this drug solution, if the abnormality detection section 4 performs detection actuation, even if normal, it will be judged that it is unusual. Then, it decides on sufficient time amount tw taken for the concentration current value of mixed processing liquid to reach concentration desired value from supply initiation of a drug solution, and after this time delay tw passes since supply initiation of a drug solution, the abnormality detection section 4 is constituted so that detection actuation of abnormalities may be started. The above-mentioned time delay tw can be beforehand decided by experiment.

[0054] Next, the configuration of the 2nd example equipment of this invention is explained with reference to drawing 6 and drawing 7 . Drawing 6 is drawing showing the whole 2nd example equipment configuration of this invention, and drawing 7 is the block diagram showing the configuration of the control system.

[0055] This 2nd example is one example of the substrate processor of single wafer processing which performs surface treatment of Substrate W with the mixed processing liquid which mixed pure water and one or more kinds of drug solutions, and was obtained as two or more kinds of processing liquid.

[0056] That is, the front face of the substrate W held at the spin chuck 11 which one substrate W is held [spin chuck] to a horizontal position, and makes the substrate processing section 1 rotate it by the circumference of the axial center J of the direction of a vertical, or the spin chuck 11 is equipped with the nozzle 12 which carries out blowout supply of the mixed processing liquid. In this substrate processing section 1, holding Substrate W to a spin chuck 11, and rotating it by the circumference of an axial center J, blowout supply of the mixed processing liquid is carried out on the front face of Substrate W from the nozzle 12 between predetermined time, and surface treatment of Substrate W is performed.

[0057] The mixed processing liquid feed zone 2 is equipped with the mixed reservoir tank 31 as the mixed section. The mixed reservoir tank 31 is equipped with upper limit sensor 31a and minimum sensor 31b in order to detect the storage of the mixed processing liquid currently stored by the mixed reservoir tank 31. These sensors 31a and 31b consist of for example, electrostatic-capacity sensors etc. It is prepared in order to prevent that mixed processing liquid overflows the mixed reservoir tank 31 for upper limit sensor 31a, and minimum sensor 31b is prepared in order to prevent the lack of a residue of the mixed processing liquid stored by the mixed reservoir tank 31. The detection signal from each sensors 31a and 31b is given to a control section 30.
[0058] Drainage-tube 32b for discharging the mixed processing liquid currently stored by the mixed reservoir tank 31 to effluent drain 32a is prepared in the pars basilaris ossis occipitalis of the mixed reservoir tank 31. Closing motion valve 32c is arranged in drainage-tube 32b. For example, when newly obtaining the mixed processing liquid into which mixed conditions were changed, after making closing motion valve 32c open, discharging the current mixed processing liquid currently stored by the mixed reservoir tank 31 to effluent drain 32a, carrying out the mixed reservoir tank 31 to empty and carrying out closing motion valve 32c to close after that, mixing of new mixed processing liquid is started. Closing motion control of closing motion valve 32c is performed by the control section 30.
[0059] Pure water and a drug solution are mixed by the mixed reservoir tank 31, and the mixed processing liquid currently stored by the mixed reservoir tank 31 is supplied to the nozzle 12 in the substrate processing section 1 by the mixed processing liquid supply system 33.
[0060] Free passage connection of the end side was made into the mixed reservoir tank 31, and this mixed processing liquid supply system 33 equips the nozzle 12 with mixed processing liquid supply pipe 33a by which free passage connection of the other end side was made, and feedback tubing 33b. 33d of diverter valves switched by the side which passes to feedback tubing 33b is arranged in mixed processing liquid supply pipe 33a the side which supplies pump 33c, the same concentration monitor 26 of a configuration as the 1st example, and mixed processing liquid to a nozzle 12. The mixed processing liquid currently stored in the mixed reservoir tank 31 by pump 33c is sent out to mixed processing liquid supply pipe 33a. Free passage connection of the end side is made at 33d of diverter valves, and, as for feedback tubing 33b, free passage connection of the other end side is made at the mixed reservoir tank 31.
[0061] At the time of usual, pump 33c is always driven and the mixed processing liquid currently stored by the mixed reservoir tank 31 is sent out to mixed processing liquid supply pipe 33a. Only when supplying and carrying out surface treatment of the mixed processing liquid to Substrate W from a nozzle 12, 33d of diverter valves is switched to the side which supplies mixed processing liquid to a nozzle 12, and 33d of diverter valves is switched to the side which pours mixed processing liquid to feedback tubing 33b at the time of other un-processing. Therefore, mixed processing liquid circulates through mixed processing liquid supply pipe 33a and feedback tubing 33b at the time of un-processing. Actuation control of pump 33c and switch control of 33d of diverter valves are performed by the control section 30. Moreover, the concentration of the mixed processing liquid which is circulating to mixed processing liquid supply pipe 33a is measured by the concentration monitor 26, and is given to a control section 30 and the abnormality detection section 4 of the same configuration as the 1st example.
[0062] While pure water is supplied from the pure-water supply system 23, each drug solution is supplied to the mixed reservoir tank 31 from 1 or two or more drug solution supply systems 34.
[0063] The pure-water supply system 23 is the same configuration as the thing of the 1st example, and is equipped with 23d of pure-water closing motion valves, and pure-water pressure controller 23c and electro-pneumatic-converter 23e which constitute pure-water supply-flow-rate regulatory mechanism 25P. [pure-water supply pipe 23b which supplies pure water to the mixed reservoir tank 31 from pure-water supply source 23a, and] Control of each part article of the pure-water supply system 23 is performed by the control section 30.
[0064] Free passage connection of the end side was made at drug solution reservoir tank 34a which stores a drug solution, and drug solution reservoir tank 34a, and the drug solution supply system 34 of the 2nd example equips the mixed reservoir tank 31 with drug solution supply pipe

34b by which free passage connection of the other end side was made, and pump 34c arranged in drug solution supply pipe 34b. It consists of pumps of capacity molds, such as a diaphragm pump and a bellows pump, and pump 34c supplies the drug solution which repeats attraction of the drug solution stored by drug solution reservoir tank 34a and the regurgitation of the drug solution to the mixed reservoir tank 31, and is stored by drug solution reservoir tank 34a through drug solution supply pipe 34b to the mixed reservoir tank 31. Moreover, this pump 34c is making the drug solution supply-flow-rate accommodation means serve a double purpose, and the supply flow rate of the drug solution to the mixed reservoir tank 31 per unit time amount is suitably adjusted according to the driving signal (drug solution supply-flow-rate manipulate signal) of pump 34c from a control section 30 by changing attraction of a drug solution and the period of the regurgitation, or changing discharge quantity of one attraction and discharging. The driving signal of pump 34c from a control section 30 is also given to the abnormality detection section 4.

[0065] Since other configurations are the same as that of the 1st example, a common part attaches the same sign as drawing 1 and drawing 2 , and omits explanation.

[0066] Next, actuation of this 2nd example equipment is explained. At the initiation event which mixes new mixed processing liquid, the mixed reservoir tank 31 shall be sky condition, and 33d of diverter valves shall be switched to the side which pours mixed processing liquid to feedback tubing 33b.

[0067] In this condition, a control section 30 performs supply of the pure water to the mixed reservoir tank 31, and a drug solution first according to the pure-water supply-flow-rate desired value and drug solution supply-flow-rate desired value according to the mixed conditions set up from the setter 3.

[0068] Moreover, if the pure water to the mixed reservoir tank 31 and supply of a drug solution are started, a control section 30 will drive pump 33c, and will circulate mixed processing liquid through mixed processing liquid supply pipe 33a and feedback tubing 33b. Although pure water and a drug solution mix together without abbreviation nonuniformity and it is carried out in case mixed processing liquid is sent out to mixed processing liquid supply pipe 33a by pump 33c, proper agitator styles, such as a static mixer, are prepared in the upstream of the concentration monitor 26, and you may make it mix pure water and a drug solution if needed that there is certainly no nonuniformity.

[0069] After starting the pure water to the mixed reservoir tank 31, and supply of a drug solution, when the predetermined time decided beforehand passes, a control section 30 Maintaining the supply flow rate of the pure water to the mixed reservoir tank 31 to pure-water supply-flow-rate desired value It switches to the feedback control which gives a driving signal which negates the concentration deflection of the concentration desired value of mixed processing liquid and the concentration current value of the mixed processing liquid from the concentration monitor 26 which are decided from the set-up mixed conditions to pump 34c, and adjusts the supply flow rate of the drug solution to the mixed reservoir tank 31. Henceforth, if supply of pure water and a drug solution is performed and mixed processing liquid is stored by feedback control in the mixed reservoir tank 31 to an upper limit height location, supply of pure water and a drug solution will stop, driving pump 33c and circulating mixed processing liquid until mixed processing liquid is stored in the mixed reservoir tank 31 to the upper limit height location in which upper limit sensor 31a was prepared by the signal from upper limit sensor 31a. Even after suspending supply of pure water and a drug solution, actuation of pump 33c is continued and in addition, circulating mixed processing liquid is continued.

[0070] On the other hand, the abnormality detection section 4 performs detection actuation of abnormalities based on pure water, the concentration current value from the between to the supply interruption of a drug solution, and the concentration monitor 26, the pure-water supply-flow-rate manipulate signal given to electro-pneumatic-converter 23e from a control section 30, and the driving signal (drug solution supply-flow-rate manipulate signal) of pump 34c from a control section 30, after a control section 30 switches to the above-mentioned fee back control and the predetermined time delay tw passes. The above-mentioned time delay tw of this 2nd example is the thing of the same meaning as the time delay tw of the 1st example of the above,

is sufficient time amount taken [after a control section 30 switches to the above-mentioned fee back control] for the concentration current value of mixed processing liquid to reach concentration desired value, and is beforehand decided by experiment.
[0071] Moreover, [whether it separated from detection actuation of the abnormalities of this 2nd example like the 1st example from the concentration tolerance which the concentration current value determined beforehand according to concentration desired value, and] Or [whether the pure-water supply-flow-rate manipulate signal given to electro-pneumatic-converter 23e separated from the fluctuation tolerance beforehand decided according to the desired value of the pure-water supply-flow-rate manipulate signal corresponding to concentration desired value, and] Or when the driving signal of pump 34c separates from the fluctuation tolerance beforehand decided according to the desired value of the driving signal corresponding to concentration desired value, it is judged that abnormalities occurred. If abnormalities are detected, the exception-processing section 5 will perform exception processing. In this 2nd example, as exception processing, the exception-processing section 5 performs processing which suspends actuation of each pump 34c and suspends the pure water to the mixed reservoir tank 31, and supply of all drug solutions, and processing which emits an alarm from an alarm 51 while making close 23d of pure-water closing motion valves. Useless consumption of pure water after the birth [from abnormalities] and a drug solution can be lost by this, and an operator can know generating of abnormalities immediately with an alarm. In addition, in this 2nd example, at the time of an abnormal occurrence, since it is not immersed in mixed processing liquid in Substrate W, even if it suspends the pure water to the mixed reservoir tank 31, and supply of all drug solutions, the poor processing to Substrate W does not break out.
[0072] Mixed processing liquid is stored in a mixed reservoir tank 31 to an upper limit height location, and when performing surface treatment of Substrate W in the condition continue actuation of pump 33c and continue circulating mixed processing liquid, a control section 30 will switch in 33d of diverter valves to the side which passes to feedback tubing 33b in mixed processing liquid, if a switch and the predetermined processing time pass in 33d of diverter valves to the side which supplies mixed processing liquid to a nozzle 12. Henceforth, whenever it performs surface treatment of Substrate W, the above-mentioned actuation is repeated.
[0073] On the other hand, if the abnormality detection section 4 supervises the concentration current value of the mixed processing liquid from the concentration monitor 26 and a concentration current value separates from concentration tolerance after storing mixed processing liquid in the mixed reservoir tank 31 to an upper limit height location, it will judge that abnormalities occurred. In this case, the exception-processing section 5 emits an alarm from an alarm 51 as exception processing.
[0074] Whenever it performs surface treatment of Substrate W, the mixed processing liquid currently stored by the mixed reservoir tank 31 decreases in number gradually. When the mixed processing liquid in the mixed reservoir tank 31 decreases in number to the minimum height location in which minimum sensor 31b was prepared by the signal from minimum sensor 31b, and a control section 30 By feedback control, supplying pure water to the mixed reservoir tank 31 uniformly with the supply flow rate of pure-water supply-flow-rate desired value Give a driving signal which negates the concentration deflection of the concentration desired value of mixed processing liquid and the concentration current value of the mixed processing liquid from the concentration monitor 26 which are decided from the set-up mixed conditions to pump 34c, and a drug solution is supplied to the mixed reservoir tank 31. If mixed processing liquid is stored in the mixed reservoir tank 31 to an upper limit height location, supply of pure water and a drug solution will be suspended.
[0075] If detection actuation of abnormalities based on the pure-water supply-flow-rate manipulate signal with which the abnormality detection section 4 is given to electro-pneumatic-converter 23e from the concentration current value from the concentration monitor 26 and a control section 30 at this time, and the driving signal (drug solution supply-flow-rate manipulate signal) of pump 34c from a control section 30 is performed and abnormalities are detected, the exception-processing section 5 will suspend the pure water to the mixed reservoir tank 31, and supply of a drug solution, and will emit an alarm from an alarm 51.

[0076] in addition, in changing mixed conditions and mixing new mixed processing liquid A control section 30 discharges the current mixed processing liquid which makes closing motion valve 32c open, and is stored by the mixed reservoir tank 31 to effluent drain 32a. After emptying the mixed reservoir tank 31, closing motion valve 32c is made close, and the mixed reservoir tank 31 mentioned above starts the actuation from sky condition, and mixes new mixed processing liquid.

[0077] If the abnormality detection section 4 detects the abnormalities of the mixed processing liquid feed zone 2 and detects abnormalities by the above actuation, mixing the mixed processing liquid used for the surface treatment of Substrate W by the mixed reservoir tank 31, the exception-processing section 5 will perform predetermined exception processing. That is, this invention is applicable also in the substrate processor of a configuration like this 2nd example.
[0078] In addition, in the 1st and 2nd example of the above, although the supply flow rate of the pure water to the mixed section 21 and the mixed reservoir tank 31 is adjusted by the pure-water pressure, you may adjust with a flow control valve, a pump, etc.
[0079] Moreover, the supply flow rate of the drug solution of the 1st example may be adjusted with a pressure controller, a pump, etc., and the supply flow rate of the drug solution of the 2nd example may be adjusted by the pressure controller, a flow control valve, etc.
[0080] Although supply of the pure water to the mixed section 21 and the mixed reservoir tank 31 was made into the fixed supply flow rate and adjusting the supply flow rate of the drug solution to the mixed section 21 and the mixed reservoir tank 31 performed concentration control of the mixed processing liquid by feedback control in the 1st and 2nd example of the above The supply flow rate of a drug solution is fixed, and even if it is equipment which adjusts the supply flow rate of pure water and performs concentration control of the mixed processing liquid by feedback control, this invention is applicable similarly.
[0081] Moreover, although it had the concentration monitor 26 and the concentration current value of mixed processing liquid was supervised, you may constitute from the 1st and 2nd example of the above, forming the flow rate sensor which replaces with the concentration monitor 26 and detects the pure water to the mixed section 21 and the mixed reservoir tank 31, and each supply flow rate of each drug solution, and computing the concentration current value of mixed processing liquid from each supply flow rate of pure water and each drug solution so that the concentration current value of mixed processing liquid may be supervised.
[0082] Moreover, although he is trying to detect an abnormal occurrence based on the concentration current value of mixed processing liquid, and processing liquid supply-flow-rate manipulate signals, such as a drug solution supply-flow-rate manipulate signal and a pure-water supply-flow-rate manipulate signal, only the concentration current value of mixed processing liquid is supervised, and you may make it detect an abnormal occurrence in the 1st and 2nd example of the above, or its modification.
[0083] Although the example which uses pure water for the processing liquid used as the solvent in mixed processing liquid was introduced in each above-mentioned example or each modification, this invention is applicable to the equipment which mixes mixed processing liquid as a solvent using processing liquid other than pure water similarly.
[0084] In addition, the overall configuration of a substrate processor is limited to the 1st and 2nd example of the above, or its modification, there are nothings and this invention can be similarly applied to the substrate processor equipped with the function which mixes two or more kinds of processing liquid by feedback control.
[0085]
[Effect of the Invention] Since according to invention according to claim 1 it detects that abnormalities, such as failure of components, occurred based on whether the concentration current value of the mixed processing liquid from a concentration monitor means separated from the predetermined concentration tolerance of mixed processing liquid and predetermined exception processing is performed so that clearly from the above explanation Abnormalities can be detected promptly, proper exception processing can be performed promptly, poor processing of a substrate can be prevented beforehand, and the dependability of equipment can be raised.
[0086] Since according to invention according to claim 2 the current value of the processing

liquid supply-flow-rate manipulate signal given to a processing liquid supply-flow-rate accommodation means from a control means is supervised further, the information on the no from which the current value of this processing liquid supply-flow-rate manipulate signal separated from the predetermined fluctuation tolerance of a processing liquid supply-flow-rate manipulate signal is also taken into consideration and an abnormal occurrence is judged, a processing liquid supply-flow-rate manipulate signal can also be taken into consideration, and generating of abnormalities, such as failure of components, can be detected more certainly.

[0087] Since the processing which suspends supply of some [at least] processing liquid to the mixed section is included as exception processing according to invention according to claim 3, the surface treatment of a substrate with the mixed processing liquid of concentration which separated from concentration desired value can be suspended, and poor processing of a substrate can be prevented beforehand, and the activity of useless processing liquid can also be lost.

[0088] According to invention according to claim 4, it is the substrate processor of the batch type which equipped the substrate processing section with the processing tub which is immersed in mixed processing liquid in two or more substrates, and performs surface preparation of each substrate. As exception processing in case two or more kinds of processing liquid supplied to the mixed section is pure water and one or more kinds of drug solutions, an exception-processing means Since supply of a drug solution will be suspended and only pure water will be supplied if an abnormal occurrence is detected by the abnormality detection means, an adverse effect with the mixed processing liquid of the abnormality concentration to two or more substrates immersed in the mixed processing liquid in a processing tub can be prevented.

[0089] Since according to invention according to claim 5 an exception-processing means will emit an alarm if an abnormal occurrence is detected by the abnormality detection means, an operator can know an abnormal occurrence promptly and a rehabilitation work can be performed promptly.

[Translation done.]

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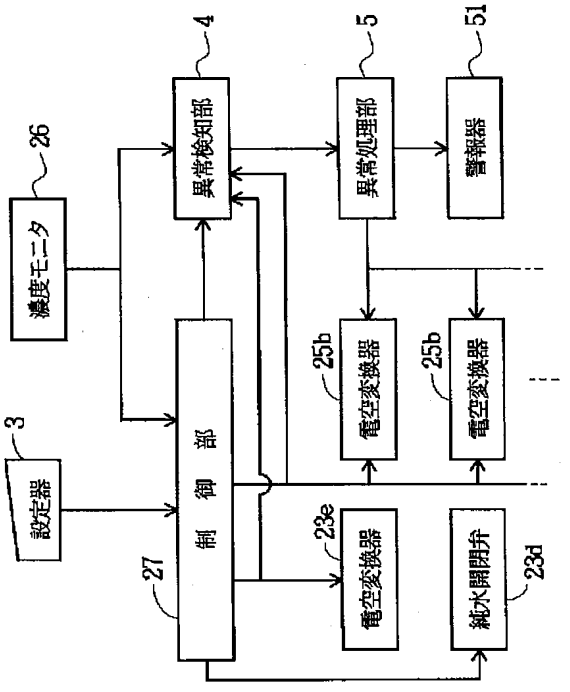
最終頁に続く

(54)【発明の名称】　基板処理装置

(57)【要約】
【課題】　部品の故障などの異常を検知して処理不良の発生を抑制する。
【解決手段】　制御部２７が濃度モニタ２６で監視される混合処理液の濃度現在値を基にフィードバック制御によって薬液供給流量調節機構を制御して濃度目標値の混合処理液を基板処理部内の処理槽に供給する機能を有する混合処理液供給部を備えた基板処理装置において、異常検知部４は、濃度モニタ２６からの混合処理液の濃度現在値が濃度許容範囲から外れたか、制御部２７から電空変換器２３ｅ、２５ｂに与えられる各処理液供給流量操作信号の現在値が各々の変動許容範囲から外れたことを検知すると、異常が発生したと判断し、異常処理部５は異常処理として混合部への薬液の供給を全て停止して処理槽に純水のみが供給される状態にし、ブザーやランプなどの警報器５１を作動させて警報を発する。



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【特許請求の範囲】

【請求項１】　複数種類の処理液を混合して得られた混合処理液で基板の表面処理を行う基板処理部と、
複数種類の処理液を混合する混合部と、
前記混合部で混合された混合処理液を前記基板処理部に供給する混合処理液供給系と、
前記混合部に個々の処理液を個別に供給する複数の処理液供給系と、
前記混合部への処理液の供給流量を調節する処理液供給流量調節手段と、
混合処理液の濃度現在値を監視する濃度監視手段と、
混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような処理液供給流量操作信号を前記処理液供給流量調節手段に与える制御手段と、
混合処理液の濃度現在値が混合処理液の所定の濃度許容範囲から外れたか否かに基づいて異常が発生したことを検知する異常検知手段と、
異常発生が検知されると所定の異常処理を行う異常処理手段と、
を備えたことを特徴とする基板処理装置。

【請求項２】　請求項１に記載の基板処理装置において、
前記異常検知手段は、前記制御手段から前記処理液供給流量調節手段に与えられる処理液供給流量操作信号の現在値をさらに監視し、この処理液供給流量操作信号の現在値が処理液供給流量操作信号の所定の変動許容範囲から外れたか否かの情報も考慮して異常発生の判定を行うことを特徴とする基板処理装置。

【請求項３】　請求項１または２に記載の基板処理装置において、
前記異常処理手段が行う異常処理は、前記混合部への少なくとも一部の処理液の供給を停止する処理を含むことを特徴とする基板処理装置。

【請求項４】　請求項１または２に記載の基板処理装置において、
前記基板処理部は、混合処理液に複数枚の基板を浸漬して各基板の表面処理を行う処理槽を備えており、
前記混合部へ供給する複数種類の処理液は、純水と１種類以上の薬液であり、
前記異常処理手段は、異常発生が検知されると薬液の供給を停止し、純水のみを供給することを特徴とする基板処理装置。

【請求項５】　請求項１ないし４のいずれかに記載の基板処理装置において、
前記異常処理手段が行う異常処理は、警報を発する処理を含むことを特徴とする基板処理装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、複数種類の処理液を混合して得られた混合処理液で、半導体ウエハや液晶表示器用のガラス基板、フォトマスク用のガラス基板、光ディスク用の基板などの基板の表面処理を行う枚葉式やバッチ式の基板処理装置に関する。

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【０００２】

【従来の技術】従来のこの種の基板処理装置は、複数種類の処理液を混合して得られた混合処理液で基板の表面処理を行う基板処理部と、複数種類の処理液を混合し、得られた混合処理液を基板処理部に供給する混合処理液供給部とを備えている。

【０００３】混合処理液供給部は、例えば、複数種類の処理液を混合する混合部と、混合部で混合された混合処理液を基板処理部に供給する混合処理液供給系と、混合部に個々の処理液を個別に供給する複数の処理液供給系と、与えられた処理液供給流量操作信号に応じて、混合部への処理液の供給流量を調節する処理液供給流量調節機構と、混合処理液の濃度現在値を監視する濃度監視機構と、混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような処理液供給流量操作信号を処理液供給流量調節機構に与える制御部とを備えて、制御部が濃度監視機構で監視される混合処理液の濃度現在値を基にフィードバック制御によって処理液供給流量調節機構を制御して濃度目標値の混合処理液を基板処理部に供給する機能を有している。

【０００４】

【発明が解決しようとする課題】しかしながら、上述したように、フィードバック制御によって混合処理液の混合を行う混合処理液供給部を備えた基板処理装置の場合、次のような問題がある。

【０００５】すなわち、処理液供給流量調節機構は、例えば、圧力調節器や流量調節弁、ポンプなどで構成され、濃度監視機構は、例えば、混合部で混合された後の混合処理液に対する透過光の強度に基づいて、混合処理液の濃度を得る濃度モニタ、あるいは、混合部への各処理液の供給流量の現在値を監視してこれら各処理液の供給流量の現在値から混合処理液の濃度現在値を算出して監視する機構などで構成され、制御部は、例えば、ＣＰＵやメモリなどを備えたマイクロコンピューターなどで構成されているが、これら部品の１つでも故障などが起きれば、濃度目標値通りの混合処理液を安定して基板処理部に供給できなくなる可能性があり、基板の表面処理を適正に行えなくなる事態が生じ得る。

【０００６】例えば、濃度監視機構の故障によって、制御部で認識される混合処理液の濃度現在値が、混合処理液の実際の濃度と一致しなくなる可能性がある。この場合、混合処理液の実際の濃度と相違する濃度を基に制御部が濃度目標値の混合処理液を得るようにフィードバック制御することになる。そのため、制御部で濃度目標値の混合処理液が得られていると認識しているとき、実際には、濃度目標値と相違する混合処理液を混合して基板処理部に供給していることになる。

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【特許請求の範囲】
【請求項１】　複数種類の処理液を混合して得られた混合処理液で基板の表面処理を行う基板処理部と、
複数種類の処理液を混合する混合部と、
前記混合部で混合された混合処理液を前記基板処理部に供給する混合処理液供給系と、
前記混合部に個々の処理液を個別に供給する複数の処理液供給系と、
前記混合部への処理液の供給流量を調節する処理液供給流量調節手段と、
混合処理液の濃度現在値を監視する濃度監視手段と、
混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような処理液供給流量操作信号を前記処理液供給流量調節手段に与える制御手段と、
混合処理液の濃度現在値が混合処理液の所定の濃度許容範囲から外れたか否かに基づいて異常が発生したことを検知する異常検知手段と、
異常発生が検知されると所定の異常処理を行う異常処理手段と、
を備えたことを特徴とする基板処理装置。
【請求項２】　請求項１に記載の基板処理装置において、
前記異常検知手段は、前記制御手段から前記処理液供給流量調節手段に与えられる処理液供給流量操作信号の現在値をさらに監視し、この処理液供給流量操作信号の現在値が処理液供給流量操作信号の所定の変動許容範囲から外れたか否かの情報も考慮して異常発生の判定を行うことを特徴とする基板処理装置。
【請求項３】　請求項１または２に記載の基板処理装置において、
前記異常処理手段が行う異常処理は、前記混合部への少なくとも一部の処理液の供給を停止する処理を含むことを特徴とする基板処理装置。
【請求項４】　請求項１または２に記載の基板処理装置において、
前記基板処理部は、混合処理液に複数枚の基板を浸漬して各基板の表面処理を行う処理槽を備えており、
前記混合部へ供給する複数種類の処理液は、純水と１種類以上の薬液であり、
前記異常処理手段は、異常発生が検知されると薬液の供給を停止し、純水のみを供給することを特徴とする基板処理装置。
【請求項５】　請求項１ないし４のいずれかに記載の基板処理装置において、
前記異常処理手段が行う異常処理は、警報を発する処理を含むことを特徴とする基板処理装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、複数種類の処理液を混合して得られた混合処理液で、半導体ウエハや液晶表示器用のガラス基板、フォトマスク用のガラス基板、光ディスク用の基板などの基板の表面処理を行う枚葉式やバッチ式の基板処理装置に関する。

2

【０００２】
【従来の技術】従来のこの種の基板処理装置は、複数種類の処理液を混合して得られた混合処理液で基板の表面処理を行う基板処理部と、複数種類の処理液を混合し、得られた混合処理液を基板処理部に供給する混合処理液供給部とを備えている。
【０００３】混合処理液供給部は、例えば、複数種類の処理液を混合する混合部と、混合部で混合された混合処理液を基板処理部に供給する混合処理液供給系と、混合部に個々の処理液を個別に供給する複数の処理液供給系と、与えられた処理液供給流量操作信号に応じて、混合部への処理液の供給流量を調節する処理液供給流量調節機構と、混合処理液の濃度現在値を監視する濃度監視機構と、混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような処理液供給流量操作信号を処理液供給流量調節機構に与える制御部とを備えて、制御部が濃度監視機構で監視される混合処理液の濃度現在値を基にフィードバック制御によって処理液供給流量調節機構を制御して濃度目標値の混合処理液を基板処理部に供給する機能を有している。
【０００４】
【発明が解決しようとする課題】しかしながら、上述したように、フィードバック制御によって混合処理液の混合を行う混合処理液供給部を備えた基板処理装置の場合、次のような問題がある。
【０００５】すなわち、処理液供給流量調節機構は、例えば、圧力調節器や流量調節弁、ポンプなどで構成され、濃度監視機構は、例えば、混合部で混合された後の混合処理液に対する透過光の強度に基づいて、混合処理液の濃度を得る濃度モニタ、あるいは、混合部への各処理液の供給流量の現在値を監視してこれら各処理液の供給流量の現在値から混合処理液の濃度現在値を算出して監視する機構などで構成され、制御部は、例えば、ＣＰＵやメモリなどを備えたマイクロコンピューターなどで構成されているが、これら部品の１つでも故障などが起きれば、濃度目標値通りの混合処理液を安定して基板処理部に供給できなくなる可能性があり、基板の表面処理を適正に行えなくなる事態が生じ得る。
【０００６】例えば、濃度監視機構の故障によって、制御部で認識される混合処理液の濃度現在値が、混合処理液の実際の濃度と一致しなくなる可能性がある。この場合、混合処理液の実際の濃度と相違する濃度を基に制御部が濃度目標値の混合処理液を得るようにフィードバック制御することになる。そのため、制御部で濃度目標値の混合処理液が得られていると認識しているとき、実際には、濃度目標値と相違する混合処理液を混合して基板処理部に供給していることになる。

【０００７】また、例えば、制御部の故障や誤動作によって、制御部から処理液供給流量調節機構に与える処理液供給流量操作信号の値が、濃度目標値に対応した操作信号の目標値から大きくズレる可能性がある。この場合、制御部によるフィードバック制御が安定せず、得られる混合処理液の濃度が発振して、濃度目標値の混合処理液が安定して得られなくなる。

【０００８】また、処理液供給流量調節機構の故障によって、制御部から与えられる処理液供給流量操作信号に応じた処理液の供給流量の調節と相違する調節を行う場合にも、制御部によるフィードバック制御が安定せず、得られる混合処理液の濃度が発振して、濃度目標値の混合処理液が安定して得られなくなる。

【０００９】その他、濃度監視機構や制御部、処理液供給流量調節機構以外の混合処理液供給部内の部品が故障しても、濃度目標値通りの混合処理液を安定して基板処理部に供給できなくなる可能性もある。

【００１０】しかしながら、従来、混合処理液供給部内の部品の故障などを監視しておらず、作業者は、基板の処理不良が発生してはじめて混合処理液供給部に異常が起きたことを知るに至っている。そのため、従来、混合処理液供給部内の部品が故障すると基板の処理不良の発生が避けられず装置への信頼性の低下を招くという問題がある。また、基板の処理不良が発生したことを作業者が知るまで、処理不良の基板を継続して製造し続けることになり、処理不良の基板を多数製造する恐れもある。さらに、基板処理によっては、処理不良の結果、回復不可能な破損を基板に与えて基板を廃棄しなければならない場合もあり、そのような場合には、ユーザーは多大の損害を被ることになる。特に、バッチ式の基板処理装置は、複数枚の基板をまとめて混合処理液に浸漬して処理するので、混合処理液供給部に異常が発生すると１度に多数の基板の処理不良が発生し、処理不良の結果、基板を廃棄しなければならない場合には、損害額は膨大なものになる。

【００１１】本発明は、このような事情に鑑みてなされたものであって、部品の故障などの異常発生を検知して、基板の処理不良の発生を抑制し、信頼性の高い基板処理装置を提供することを目的とする。

【００１２】

【課題を解決するための手段】本発明は、このような目的を達成するために、次のような構成をとる。すなわち、請求項１に記載の発明は、複数種類の処理液を混合して得られた混合処理液で基板の表面処理を行う基板処理部と、複数種類の処理液を混合する混合部と、前記混合部で混合された混合処理液を前記基板処理部に供給する混合処理液供給系と、前記混合部に個々の処理液を個別に供給する複数の処理液供給系と、前記混合部への処理液の供給流量を調節する処理液供給流量調節手段と、混合処理液の濃度現在値を監視する濃度監視手段と、混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような処理液供給流量操作信号を前記処理液供給流量調節手段に与える制御手段と、混合処理液の濃度現在値が混合処理液の所定の濃度許容範囲から外れたか否かに基づいて異常が発生したことを検知する異常検知手段と、異常発生が検知されると所定の異常処理を行う異常処理手段と、を備えたことを特徴とするものである。

【００１３】請求項２に記載の発明は、上記請求項１に記載の基板処理装置において、前記異常検知手段は、前記制御手段から前記処理液供給流量調節手段に与えられる処理液供給流量操作信号の現在値をさらに監視し、この処理液供給流量操作信号の現在値が処理液供給流量操作信号の所定の変動許容範囲から外れたか否かの情報も考慮して異常発生の判定を行うことを特徴とするものである。

【００１４】請求項３に記載の発明は、上記請求項１または２に記載の基板処理装置において、前記異常処理手段が行う異常処理は、前記混合部への少なくとも一部の処理液の供給を停止する処理を含むことを特徴とするものである。

【００１５】請求項４に記載の発明は、上記請求項１または２に記載の基板処理装置において、前記基板処理部は、混合処理液に複数枚の基板を浸漬して各基板の表面処理を行う処理槽を備えており、前記混合部へ供給する複数種類の処理液は、純水と１種類以上の薬液であり、前記異常処理手段は、異常発生が検知されると薬液の供給を停止し、純水のみを供給することを特徴とするものである。

【００１６】請求項５に記載の発明は、上記請求項１ないし４のいずれかに記載の基板処理装置において、前記異常処理手段が行う異常処理は、警報を発する処理を含むことを特徴とするものである。

【００１７】

【作用】請求項１に記載の発明の作用は次のとおりである。以下のようにして、複数種類の処理液を混合し、得られた混合処理液を基板処理部に供給する。

【００１８】すなわち、複数の処理液供給系から複数種類の処理液が混合部に供給され、各処理液が混合部で混合されて混合処理液が得られる。この混合処理液が混合処理液供給系によって基板処理部に供給され、基板処理部においてこの混合処理液で基板の表面処理が行われる。

【００１９】混合部への処理液の供給流量は、制御手段から与えられた処理液供給流量操作信号に応じて、処理液供給流量調節手段によって調節される。

【００２０】また、濃度監視手段は混合処理液の濃度現在値を監視しており、制御手段は混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような処理液供給流量操作信号を処理液供給流量調節手段

に与えて、フィードバック制御により、混合処理液の混合を行う。

【００２１】上記構成の装置において、濃度監視手段や制御手段、処理液供給流量調節手段などの部品が故障すると、混合処理液の濃度現在値が濃度目標値からズレたり、濃度が発振して不安定になったりする可能性がある。従って、混合処理液の濃度目標値を中心に適宜の濃度上限値と濃度下限値とを設定してその間の濃度幅を濃度許容範囲として、混合処理液の濃度現在値がその濃度許容範囲内に収束しているか濃度許容範囲から外れたかにより、部品の故障などの異常の発生を検知することができる。

【００２２】そこで、異常検知手段は、濃度監視手段からの混合処理液の濃度現在値が混合処理液の所定の濃度許容範囲から外れたか否かに基づいて異常が発生したことを検知し、異常検知手段によって異常発生が検知されると、異常処理手段が、例えば、請求項３ないし５に記載の発明のような所定の異常処理を行う。

【００２３】請求項２に記載の発明では、異常検知手段は、制御手段から処理液供給流量調節手段に与えられる処理液供給流量操作信号の現在値をさらに監視し、この処理液供給流量操作信号の現在値が処理液供給流量操作信号の所定の変動許容範囲から外れたか否かの情報も考慮して異常発生の判定を行う。濃度監視手段等の部品の故障などの異常が発生すると、制御手段から処理液供給流量調節手段に与えられる処理液供給流量操作信号が、混合処理液の濃度目標値に対応する処理液供給流量操作信号の目標値から大きくズレたり、発振して不安定になったりする可能性がある。従って、混合処理液の濃度目標値に対応する処理液供給流量操作信号の目標値を中心に適宜の操作信号上限値と操作信号下限値とを設定してその間の操作信号幅を変動許容範囲とすれば、制御手段から処理液供給流量調節手段に与えられる処理液供給流量操作信号の現在値が処理液供給流量操作信号の所定の変動許容範囲から外れたか否かの情報も異常発生の判定に用いることができる。この請求項２に記載の発明によれば、処理液供給流量操作信号も考慮して部品の故障などの異常の発生をより確実に検知することができる。

【００２４】請求項３に記載の発明によれば、異常検知手段によって異常発生が検知されると、異常処理手段は、異常処理として、混合部への少なくとも一部の処理液の供給を停止する。異常処理手段は、装置構成や動作状況などに応じて混合部への全ての処理液の供給を停止してもよいし、例えば、請求項４に記載の発明のように、基板に支障のある処理液の混合部への供給を停止し、基板に支障のない処理液の混合部への供給は継続してもよい。

【００２５】請求項４に記載の発明は、混合処理液に複数枚の基板を浸漬して各基板の表面処理を行う処理槽を基板処理部に備えたバッチ式の基板処理装置であって、混合部へ供給する複数種類の処理液が純水と１種類以上の薬液である場合の異常処理であり、異常処理手段は、異常検知手段によって異常発生が検知されると基板に支障のある処理液である薬液の供給を停止し、基板に支障のない処理液である純水のみを供給する。

【００２６】請求項５に記載の発明によれば、異常処理手段は、異常検知手段によって異常発生が検知されると警報を発する。

【００２７】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態を説明する。図１は本発明の第１実施例に係る基板処理装置の全体構成を示す図であり、図２はその制御系の構成を示すブロック図である。

【００２８】この第１実施例装置は、複数種類の処理液としての純水と１種類以上の薬液とを混合して得られた混合処理液で基板Ｗの表面処理を行うバッチ式の基板処理装置の一実施例である。

【００２９】この装置は、大きく分けて、混合処理液に複数枚の基板Ｗを浸漬して各基板Ｗの表面処理を行う処理槽１０を備えた基板処理部１と、純水と薬液とを混合し、得られた混合処理液を基板処理部１内の処理槽１０に供給する混合処理液供給部２と、混合処理液の濃度目標値を決める混合条件などを設定する設定器３と、異常検知部４及び異常処理部５を備えている。

【００３０】処理槽１０は、槽底部から混合処理液の供給を受け、余剰の混合処理液をオーバーフローさせて排出させるように構成されている。処理槽１０から排出された混合処理液は、廃棄するように構成してもよいし、混合処理液供給部２に戻して再利用するようにしてもよい。

【００３１】混合処理液供給部２は、純水と各薬液を混合する混合部２１と、混合部２１で混合された混合処理液を基板処理部１内の処理槽１０に供給する混合処理液供給系２２と、混合部２１に純水を供給する純水供給系２３と、混合部２１に各薬液を個別に供給する１または複数の薬液供給系２４と、与えられた純水供給流量操作信号（処理液供給流量操作信号）に応じて、混合部２１への純水の供給流量を調節する純水供給流量調節機構２５Ｐと、与えられた薬液供給流量操作信号（処理液供給流量操作信号）に応じて、混合部２１への各薬液の供給流量を調節する薬液供給流量調節機構２５Ｑと、混合処理液の濃度現在値を監視するための濃度モニタ２６と、混合処理液の濃度目標値と混合処理液の濃度現在値との濃度偏差を打ち消すような薬液供給流量操作信号を薬液供給流量調節機構２５Ｑに与える制御部２７とを備えている。この制御部２７は濃度モニタ２６で監視される混合処理液の濃度現在値を基にフィードバック制御によって薬液供給流量調節機構２５Ｑを制御して濃度目標値の混合処理液を基板処理部１内の処理槽１０に供給する機能を有している。

【００３２】混合部２１は、純水流路２１ａと、純水流路２１ａに各薬液を導入する各薬液導入路２１ｂとが形成された混合管２１ｃを備えており、純水流路２１ａに流通している純水に各薬液導入路２１ｂから各薬液を導入して純水と薬液とを混合して純水流路２１ａの出口２１ｄから混合処理液が排出されるように構成されている。純水流路２１ａの出口２１ｄに、例えば孔空きのねじり板などからなるスタティックミキサーなどの適宜の撹拌機構を配設して、純水と各薬液とをムラなく混合できるように構成してもよい。

【００３３】混合処理液供給系２２は、混合部２１を構成する混合管２１ｃの純水流路２１ａの出口２１ｄに一端側が連通接続され、処理槽１０の底部に他端側が連通接続された混合処理液供給管２２ａを備えている。この混合処理液供給管２２ａの管路途中に濃度モニタ２６が配設されている。この濃度モニタ２６は、混合部２１で混合された後の混合処理液に対する透過光や反射光の強度に基づいて、混合処理液の濃度、すなわち、混合処理液中の薬液の濃度を計測することができる。なお、この種の濃度モニタ２６は、各々の薬液の分光特性が相違していれば、純水に複数種類の薬液を混合した場合でも、混合処理液内の各々の薬液の濃度を個別に得ることができる。

【００３４】純水供給系２３には、純水供給源２３ａに一端側が連通接続され、混合部２１を構成する混合管２１ｃの純水流路２１ａの入口２１ｅに他端側が連通接続された純水供給管２３ｂを備えている。純水供給管２３ｂには、純水供給源２３ａの側から順に、純水圧力調節器２３ｃ、純水開閉弁２３ｄが配設されている。純水圧力調節器２３ｃは、電空変換器２３ｅから与えられた空気圧（パイロット圧）に応じて、純水圧力調節器２３ｃの二次側の純水圧力を調節する制御弁であり、この純水圧力調節器２３ｃによって、純水圧力調節器２３ｃの二次側の純水供給路２３ｂを流通する純水の流量を一定にして、混合部２１に供給する純水の供給流量を一定にすることができる。

【００３５】電空変換器２３ｅは、供給される加圧空気（圧空）を、制御部２７からの操作電圧（純水供給流量操作信号）に応じた空気圧（パイロット圧）に変換して出力する。制御部２７は、混合部２１に供給する純水の供給流量が後述する純水供給流量目標値となるような操作電圧を電空変換器２３ｅに与えることによって、混合部２１には純水流量目標値の純水が供給される。純水圧力調節器２３ｃと電空変換器２３ｅとは、純水供給流量調節機構２５Ｐを構成する。

【００３６】純水開閉弁２３ｄは、混合部２１への純水の供給とその停止とを切り換える開閉弁であり、その開閉制御は制御部２７により行われる。

【００３７】各薬液供給系２４の構成は全て同じであるので、１つの薬液供給系２４の構成を例に説明する。薬液供給系２４は、薬液供給源２４ａに一端側が連通接続され、混合部２１を構成する混合管２１ｃの薬液導入路２１ｂに他端側が連通接続された薬液供給管２４ｂを備えている。薬液供給管２４ｂには、薬液流量調節弁２５ａが配設されている。

【００３８】薬液供給流量調節機構２５Ｑは、上記薬液流量調節弁２５ａと電空変換器２５ｂとを備えている。薬液流量調節弁２５ａに電空変換器２５ｂからパイロット圧を与えることにより、薬液流量調節弁２５ａの弁の開度を操作して、薬液供給管２４ｂの薬液流量を制御して、混合部２１への薬液の供給流量を調節することができる。なお、薬液流量調節弁２５ａは、開閉弁を兼用しており、弁を完全に閉じるように調節することもでき、弁を完全に閉じることにより、混合部２１への薬液の供給を停止することもできる。

【００３９】設定器３から設定された混合条件は制御部２７に与えられる。設定器３からは、混合条件として、混合処理液の濃度目標値（混合処理液中の各々の薬液の濃度目標値）、純水供給流量目標値、薬液供給流量目標値の全て、または、いずれか２つの目標値が設定される。いずれか２つの目標値が設定された場合には、その２つの目標値から残りの１つの目標値を算出することができる。従って、制御部２７では、混合処理液の濃度目標値、純水供給流量目標値、薬液供給流量目標値の全てを把握することができる。そこで、制御部２７は、上述したように混合部２１に供給する純水の供給流量を純水供給流量目標値に維持するような操作電圧（純水供給流量操作信号）を電空変換器２３ｅに与えるとともに、混合処理液の濃度目標値と濃度モニタ２６で監視される混合処理液の濃度現在値との濃度偏差を打ち消すような操作電圧（薬液供給流量操作信号）を電空変換器２５ｂに与える。

【００４０】すなわち、濃度モニタ２６からの混合処理液の濃度現在値が混合処理液の濃度目標値よりも小さいときには、混合部２１への薬液の供給流量を増やすような操作電圧を電空変換器２５ｂに与え、濃度モニタ２６からの混合処理液の濃度現在値が混合処理液の濃度目標値よりも大きいときには、混合部２１への薬液の供給流量を減らすような操作電圧を電空変換器２５ｂに与えて、濃度偏差が「０」となるように制御する。

【００４１】なお、上記フィードバック制御における電空変換器２５ｂへの操作電圧は、例えば、Ｐ（比例動作）、Ｉ（積分動作）、I^2（二重積分動作）、Ｄ（微分動作）を含む制御則や純水供給流量目標値などに基づき、フィードバック制御における周知の方法で算出する。また、純水に複数種類の薬液を混合する場合には、各薬液ごとの濃度目標値に基づき上記制御を各薬液ごとに並行して行う。

【００４２】この制御部２７は、ＣＰＵやメモリを備えたマイクロコンピューターなどで構成されている。

【００４３】濃度モニタ２６から制御部２７に与えられる混合処理液の濃度現在値と、制御部２７から電空変換器２３ｅ、２５ｂに与えられる操作電圧（純水供給流量操作信号、薬液供給流量操作信号）とは、異常検知部４に与えられている。また、混合処理液の濃度目標値や純水供給流量目標値、薬液供給流量目標値が、制御部２７から異常検知部４に与えられる。純水供給流量目標値に基づき、混合処理液の濃度目標値に対応する純水供給流量操作信号（制御部２７から電空変換器２３ｅに与えられる操作電圧）の目標値を求めることができ、薬液供給流量目標値に基づき、混合処理液の濃度目標値に対応する薬液供給流量操作信号（制御部２７から電空変換器２５ｂに与えられる操作電圧）の目標値を求めることができる。

【００４４】図３に示すように、混合処理液の濃度目標値がＤＴであれば、異常検知部４では、この濃度目標値ＤＴを中心に適宜の濃度上限値ＤＵと濃度下限値ＤＤとを設定してその濃度幅を濃度許容範囲ＤＷとする。濃度上限値ＤＵと濃度下限値ＤＤは、例えば、予め決めておいた定数を濃度目標値ＤＴに加算した値と減算した値としたり、予め決めておいた割合を濃度目標値ＤＴに掛け合わせた値を濃度目標値ＤＴに加算した値と減算した値としたりするなどにより設定する。なお、図３（ｂ）に示すように、濃度目標値ＤＴが経時的に変化する場合には、それに応じて濃度許容範囲ＤＷも変化させる。

【００４５】また、図４に示すように、或る処理液の処理液供給流量操作信号（純水供給流量操作信号でも薬液供給流量操作信号でもよい）の目標値がＣＳＴであれば、異常検知部４では、この処理液供給流量操作信号の目標値ＣＳＴを中心に適宜の操作信号上限値ＣＳＵと操作信号下限値ＣＳＤとを設定してその間の操作信号幅を変動許容範囲ＣＳＷとする。操作信号上限値ＣＳＵと操作信号下限値ＣＳＤは、上述した濃度上限値ＤＵと濃度下限値ＤＤと同様に方法で設定し、図４（ｂ）に示すように、処理液供給流量操作信号の目標値ＣＳＴが経時的に変化する場合には、それに応じて変動許容範囲ＣＳＷも変化させる。異常検知部４では、混合処理液の混合に使用する全ても処理液（純水及び各薬液）に対する各々の変動許容範囲ＣＳＷを求める。

【００４６】そして、異常検知部４は、濃度モニタ２６からの混合処理液の濃度現在値が濃度許容範囲ＤＷから外れたか否かの情報と、制御部２７から電空変換器２３ｅ、２５ｂに与えられる各処理液供給流量操作信号の現在値が各々の変動許容範囲ＣＳＷから外れたか否かの情報とに基づき、異常発生の判定を行う。

【００４７】異常発生が検知されると、異常処理部５は薬液流量調節弁２５ａの弁を閉じるパイロット圧を薬液流量調節弁２５ａに与えるような操作電圧を電空変換器２５ｂに与えて混合部２１への薬液の供給を全て停止し、処理槽１０に純水のみが供給される状態にするとともに、ブザーやランプなどの警報器５１を作動させて警報を発するなどの異常処理を実行する。

【００４８】異常検知部４と異常処理部５とは、制御部２７とは個別のマイクロコンピューターなどで構成されている。

【００４９】次に上記構成を有する装置の動作を説明する。まず、作業者は、設定器３から混合条件を設定する。設定された混合条件に基づき制御部２７は処理の準備を行い、異常検知部４は濃度許容範囲ＤＷと変動許容範囲ＣＳＷを設定する。

【００５０】処理槽１０に混合処理液の供給を開始するとき、処理槽１０は純水で満たされている。これは或る混合処理液を使って基板Ｗの表面処理を行った後、次の混合処理液で基板Ｗの表面処理を行う場合も同様である。すなわち、或る混合処理液による基板Ｗの表面処理が終わると、処理槽１０に純水だけが供給され、処理槽１０内の使用済みの混合処理液を一旦純水で置換する。それに続いて、処理槽１０に純水が供給されている状態で、純水中への薬液の導入を開始することにより、新たな混合処理液を処理槽１０に供給して、処理槽１０の純水を新たな混合処理液で置換する。

【００５１】制御部２７は、混合処理液の濃度目標値に応じた純水供給流量目標値の純水が混合部２１に供給するような純水供給流量操作信号を一義的に電空変換器２３ｅに与え続ける一方で、図５に示すように、薬液の供給開始から所定時間ｔｓの間は、混合処理液の濃度目標値に応じた薬液供給流量目標値の薬液が混合部２１に供給するような薬液供給流量操作信号を一義的に電空変換器２５ｂに与え、薬液の供給開始から所定時間ｔｓが経過して以後、設定された混合条件から決まる混合処理液の濃度目標値と濃度モニタ２６からの混合処理液の濃度現在値との濃度偏差を打ち消すような操作電圧を電空変換部２５ｂに与えて、フィードバック制御により混合処理液を混合する。薬液の供給開始当初は、混合部２１への薬液供給流量の立ち上がりが緩慢であるので、濃度偏差が大きくなり、このときフィードバック制御を行うと、混合処理液の濃度現在値が高くなり過ぎる、いわゆるオーバーシュートが発生する。これを防止するために、薬液の供給開始当初の所定時間ｔｓの間は、フィードバック制御を行わず、混合処理液の濃度目標値に応じた薬液供給流量目標値の薬液が混合部２１に供給するような薬液供給流量操作信号を一義的に電空変換器２５ｂに与えるようにしている。

【００５２】それと並行して、異常検知部４は、濃度モニタ２６からの混合処理液の濃度現在値が濃度許容範囲ＤＷから外れたか否か、及び、制御部２７から電空変換部２３ｅ、２５ｂに与えられる各処理液供給流量操作信号が各々の変動許容範囲ＣＳＷから外れたか否かを監視する。図５（ａ）において、混合処理液の濃度現在値が濃度許容範囲ＤＷから外れたか、または、図５（ｂ）に

おいて、各処理液供給流量操作信号が各々の変動許容範囲ＣＳＷから外れるのは、混合処理液供給部２内の部品の故障など、何らかの異常が起きたと推定できる。従って、混合処理液の濃度現在値が濃度許容範囲ＤＷから外れたか、または、各処理液供給流量操作信号が各々の変動許容範囲ＣＳＷから外れたことを検知すると、異常が発生したものと判断し、異常処理部５が、混合部２１への薬液の供給を全て停止し、処理槽１０に純水のみが供給される状態にするとともに、警報器５１から警報を発する。これにより、異常が発生すると、処理槽１０は純水に置換され、濃度目標値から外れた混合処理液に長時間基板Ｗを浸漬することがなく、基板Ｗへの損傷などを防止できる。また、警報によって異常が発生すると、作業者は異常発生を直ぐに知ることができ、適宜の復旧作業を速やかに行うことができる。

【００５３】ところで、混合処理液の供給開始の初期の純水のみが処理槽１０に供給されている状態から、混合部２１に薬液を供給し始めた当初は、図５に示すように、混合部２１への薬液供給流量の立ち上がりが緩慢であり、適宜の時間が経過した後に、混合処理液の濃度現在値が濃度目標値に到達する。従って、この薬液の供給開始の初期段階で、異常検知部４が検知動作を行えば、正常であっても異常と判断してしまう。そこで、薬液の供給開始から混合処理液の濃度現在値が濃度目標値に到達するまでに要する十分な時間ｔｗを決めて、異常検知部４は、薬液の供給開始からこの遅れ時間ｔｗが経過してから異常の検知動作を開始するように構成している。上記遅れ時間ｔｗは実験によって予め決めておくことができる。

【００５４】次に本発明の第２実施例装置の構成を図６、図７を参照して説明する。図６は本発明の第２実施例装置の全体構成を示す図であり、図７はその制御系の構成を示すブロック図である。

【００５５】この第２実施例は、複数種類の処理液として、純水と１種類以上の薬液とを混合して得られた混合処理液で基板Ｗの表面処理を行う枚葉式の基板処理装置の一実施例である。

【００５６】すなわち、基板処理部１には、１枚の基板Ｗを水平姿勢に保持して鉛直方向の軸心Ｊ周りで回転させるスピンチャック１１やスピンチャック１１に保持された基板Ｗの表面に混合処理液を噴出供給するノズル１２などを備えている。この基板処理部１では、スピンチャック１１に基板Ｗを保持して軸心Ｊ周りで回転させながら所定時間の間ノズル１２から基板Ｗの表面に混合処理液が噴出供給されて基板Ｗの表面処理が行われる。

【００５７】混合処理液供給部２は、混合部としての混合貯留タンク３１を備えている。混合貯留タンク３１には、混合貯留タンク３１に貯留されている混合処理液の貯留量を検知するために、例えば、上限センサ３１ａと下限センサ３１ｂとを備えている。これらセンサ３１ａ、３１ｂは、例えば、静電容量センサなどで構成される。上限センサ３１ａは、混合処理液が混合貯留タンク３１から溢れ出すのを防止するために設けられ、下限センサ３１ｂは、混合貯留タンク３１に貯留される混合処理液の残量不足を防止するために設けられている。各センサ３１ａ、３１ｂからの検知信号は制御部３０に与えられる。

【００５８】混合貯留タンク３１の底部には、混合貯留タンク３１に貯留されている混合処理液を排液ドレイン３２ａに排出するための排液管３２ｂが設けられている。排液管３２ｂには開閉弁３２ｃが配設されている。例えば、混合条件を変えた混合処理液を新たに得る場合に、開閉弁３２ｃを開にして、混合貯留タンク３１に貯留されている現在の混合処理液を排液ドレイン３２ａに排出して混合貯留タンク３１を空にし、その後開閉弁３２ｃを閉にしてから新たな混合処理液の混合を開始する。開閉弁３２ｃの開閉制御は制御部３０によって行われる。

【００５９】混合貯留タンク３１で純水と薬液とが混合され、混合貯留タンク３１に貯留されている混合処理液は、混合処理液供給系３３によって基板処理部１内のノズル１２に供給される。

【００６０】この混合処理液供給系３３は、混合貯留タンク３１内に一端側が連通接続され、ノズル１２に他端側が連通接続された混合処理液供給管３３ａと、帰還管３３ｂとを備えている。混合処理液供給管３３ａには、ポンプ３３ｃと、第１実施例と同様の構成の濃度モニタ２６と、混合処理液をノズル１２に供給する側と帰還管３３ｂに流す側とで切り換える切り換え弁３３ｄとが配設されている。ポンプ３３ｃによって混合貯留タンク３１に貯留されている混合処理液が混合処理液供給管３３ａに送り出される。帰還管３３ｂは、切り換え弁３３ｄに一端側が連通接続され、混合貯留タンク３１に他端側が連通接続されている。

【００６１】通常時、ポンプ３３ｃは常に駆動されていて、混合貯留タンク３１に貯留されている混合処理液が混合処理液供給管３３ａに送り出されている。ノズル１２から基板Ｗに混合処理液を供給して表面処理する時だけ、切り換え弁３３ｄは混合処理液をノズル１２に供給する側に切り換えられ、それ以外の非処理時は、切り換え弁３３ｄは混合処理液を帰還管３３ｂに流す側に切り換えられている。従って、非処理時は、混合処理液は、混合処理液供給管３３ａ及び帰還管３３ｂを経て循環されている。ポンプ３３ｃの駆動制御、及び、切り換え弁３３ｄの切り換え制御は制御部３０によって行われる。また、混合処理液供給管３３ａに流通している混合処理液の濃度が濃度モニタ２６によって計測されて制御部３０と、第１実施例と同様の構成の異常検知部４に与えられるようになっている。

【００６２】混合貯留タンク３１には、純水供給系２３

から純水が供給されるとともに、１または複数の薬液供給系３４から各薬液が供給されるようになっている。

【００６３】純水供給系２３は、第１実施例のものと同様の構成であり、純水供給源２３ａから混合貯留タンク３１へ純水を供給する純水供給管２３ｂと、純水開閉弁２３ｄと、純水供給流量調節機構２５Ｐを構成する純水圧力調節器２３ｃ及び電空変換器２３ｅとを備えている。純水供給系２３の各部品の制御は制御部３０によって行われる。

【００６４】第２実施例の薬液供給系３４は、薬液を貯留する薬液貯留タンク３４ａと、薬液貯留タンク３４ａに一端側が連通接続され、混合貯留タンク３１に他端側が連通接続された薬液供給管３４ｂと、薬液供給管３４ｂに配設されたポンプ３４ｃとを備えている。ポンプ３４ｃは、例えば、ダイアフラムポンプやベローズポンプなどの容量型のポンプで構成され、薬液貯留タンク３４ａに貯留された薬液の吸引と混合貯留タンク３１への薬液の吐出とを繰り返して薬液供給管３４ｂを介して薬液貯留タンク３４ａに貯留されている薬液を混合貯留タンク３１に供給する。また、このポンプ３４ｃは、薬液供給流量調節手段を兼用しており、制御部３０からのポンプ３４ｃの駆動信号（薬液供給流量操作信号）に応じて、薬液の吸引、吐出の周期を変えたり、１回の吸引、吐出動作の吐出量を変えたりすることで単位時間当たりの混合貯留タンク３１への薬液の供給流量を適宜に調節するようになっている。制御部３０からのポンプ３４ｃの駆動信号は異常検知部４にも与えられている。

【００６５】その他の構成は第１実施例と同様であるので、共通する部分は図１、図２と同じ符号を付して説明を省略する。

【００６６】次に、この第２実施例装置の動作を説明する。新たな混合処理液を混合する開始時点では、混合貯留タンク３１が空の状態であり、切り換え弁３３ｄは、混合処理液を帰還管３３ｂに流す側に切り換えられているものとする。

【００６７】この状態で、制御部３０は、まず、設定器３から設定された混合条件に応じた純水供給流量目標値と薬液供給流量目標値とに従って、混合貯留タンク３１への純水と薬液の供給を行う。

【００６８】また、混合貯留タンク３１への純水と薬液の供給を開始すると、制御部３０は、ポンプ３３ｃを駆動して、混合処理液を混合処理液供給管３３ａ及び帰還管３３ｂを経て循環させる。ポンプ３３ｃによって混合処理液を混合処理液供給管３３ａに送り出す際に、純水と薬液とは略ムラなく混ぜ合わされるが、必要に応じて、濃度モニタ２６の上流側にスタティックミキサーなどの適宜の撹拌機構を設けて、純水と薬液とを確実にムラなく混ぜ合わせるようにしてもよい。

【００６９】混合貯留タンク３１への純水と薬液の供給を開始してから予め決められた所定時間が経過すると、制御部３０は、混合貯留タンク３１への純水の供給流量を純水供給流量目標値に維持しつつ、設定された混合条件から決まる混合処理液の濃度目標値と濃度モニタ２６からの混合処理液の濃度現在値との濃度偏差を打ち消すような駆動信号をポンプ３４ｃに与えて混合貯留タンク３１への薬液の供給流量を調節するフィードバック制御に切り換える。以後、上限センサ３１ａからの信号によって上限センサ３１ａが設けられた上限高さ位置まで混合貯留タンク３１内に混合処理液が貯留されるまで、ポンプ３３ｃを駆動し混合処理液を循環させつつ、フィードバック制御によって純水と薬液の供給を行い、上限高さ位置まで混合貯留タンク３１内に混合処理液が貯留されると純水と薬液の供給を停止する。なお、純水と薬液の供給を停止した後もポンプ３３ｃの駆動を継続して混合処理液を循環させ続ける。

【００７０】一方で、異常検知部４は、制御部３０が上記フィーバック制御に切り換えてから所定の遅れ時間ｔｗが経過して以後、純水と薬液の供給停止までの間、濃度モニタ２６からの濃度現在値と、制御部３０から電空変換器２３ｅに与えられる純水供給流量操作信号と、制御部３０からのポンプ３４ｃの駆動信号（薬液供給流量操作信号）とに基づく異常の検知動作を行う。この第２実施例の上記遅れ時間ｔｗは、上記第１実施例の遅れ時間ｔｗと同様の趣旨のもので、制御部３０が上記フィーバック制御に切り換えてから混合処理液の濃度現在値が濃度目標値に到達するまでに要する十分な時間であり、実験によって予め決めておく。

【００７１】また、この第２実施例の異常の検知動作は、第１実施例と同様に、濃度現在値が濃度目標値に応じて予め決めた濃度許容範囲から外れたか、または、電空変換器２３ｅに与えられる純水供給流量操作信号が濃度目標値に対応した純水供給流量操作信号の目標値に応じて予め決めた変動許容範囲から外れたか、または、ポンプ３４ｃの駆動信号が濃度目標値に対応した駆動信号の目標値に応じて予め決めた変動許容範囲から外れたとき異常が発生したと判断するものである。異常が検知されると異常処理部５は異常処理を行う。この第２実施例では、異常処理部５は異常処理として、純水開閉弁２３ｄを閉にするとともに各ポンプ３４ｃの駆動を停止して混合貯留タンク３１への純水と全ての薬液の供給を停止する処理と、警報器５１から警報を発する処理を行う。これにより、異常発生後の純水と薬液の無駄な消費をなくすことができ、また、警報によって異常の発生を作業者が直ぐに知ることができる。なお、この第２実施例では、異常発生時に基板Ｗが混合処理液に浸漬されているわけではないので、混合貯留タンク３１への純水と全ての薬液の供給を停止しても基板Ｗへの処理不良は起きない。

【００７２】上限高さ位置まで混合貯留タンク３１内に混合処理液が貯留され、ポンプ３３ｃの駆動を継続して

混合処理液を循環させ続ける状態で、基板Wの表面処理を行う時には、制御部３０は、混合処理液をノズル１２に供給する側に切り換え弁３３ｄを切り換え、所定の処理時間が経過すると、混合処理液を帰還管３３ｂに流す側に切り換え弁３３ｄを切り換える。以後、基板Wの表面処理を行うごとに、上記動作を繰り返す。

【００７３】一方で、異常検知部４は、上限高さ位置まで混合貯留タンク３１内に混合処理液が貯留された以後、濃度モニタ２６からの混合処理液の濃度現在値を監視し、濃度現在値が濃度許容範囲から外れると、異常が発生したと判断する。この場合には、異常処理部５は異常処理として警報器５１から警報を発する。

【００７４】基板Wの表面処理を行うごとに、混合貯留タンク３１に貯留されている混合処理液は徐々に減少していく。そして、下限センサ３１ｂからの信号によって下限センサ３１ｂが設けられた下限高さ位置まで混合貯留タンク３１内の混合処理液が減少すると、制御部３０は、フィードバック制御により、混合貯留タンク３１へ純水供給流量目標値の供給流量で純水を一定に供給しつつ、設定された混合条件から決まる混合処理液の濃度目標値と濃度モニタ２６からの混合処理液の濃度現在値との濃度偏差を打ち消すような駆動信号をポンプ３４ｃに与えて混合貯留タンク３１へ薬液を供給し、上限高さ位置まで混合貯留タンク３１内に混合処理液が貯留されると純水と薬液の供給を停止する。

【００７５】このとき、異常検知部４は、濃度モニタ２６からの濃度現在値と、制御部３０から電空変換器２３ｅに与えられる純水供給流量操作信号と、制御部３０からのポンプ３４ｃの駆動信号（薬液供給流量操作信号）とに基づく異常の検知動作を行い、異常が検知されると、異常処理部５は、混合貯留タンク３１への純水と薬液の供給を停止し、警報器５１から警報を発する。

【００７６】なお、混合条件を変えて新たな混合処理液を混合する場合には、制御部３０は、開閉弁３２ｃを開にして混合貯留タンク３１に貯留されている現在の混合処理液を排液ドレイン３２ａに排出して、混合貯留タンク３１を空にしてから、開閉弁３２ｃを閉にし、上述した混合貯留タンク３１が空の状態からの動作を開始して新たな混合処理液の混合を行う。

【００７７】以上の動作により、基板Wの表面処理に用いる混合処理液を混合貯留タンク３１で混合しつつ、異常検知部４が混合処理液供給部２の異常を検知して、異常を検知すると、異常処理部５が所定の異常処理を行う。すなわち、本発明は、この第２実施例のような構成の基板処理装置においても適用することができる。

【００７８】なお、上記第１、第２実施例では、混合部２１、混合貯留タンク３１への純水の供給流量を純水圧力で調節しているが、流量調節弁やポンプなどで調節するものであってもよい。

【００７９】また、第１実施例の薬液の供給流量を圧力調節器やポンプなどで調節してもよいし、第２実施例の薬液の供給流量を圧力調節器や流量調節弁などで調節してもよい。

【００８０】上記第１、第２実施例では、混合部２１、混合貯留タンク３１への純水の供給を一定の供給流量にし、フィードバック制御による混合処理液の濃度制御を混合部２１、混合貯留タンク３１への薬液の供給流量を調節することで行ったが、薬液の供給流量を一定にし、純水の供給流量を調節してフィードバック制御による混合処理液の濃度制御を行う装置であっても本発明は同様に適用できる。

【００８１】また、上記第１、第２実施例では、濃度モニタ２６を備えて混合処理液の濃度現在値を監視したが、濃度モニタ２６に代えて混合部２１、混合貯留タンク３１への純水と各薬液の各々の供給流量を検出する流量センサを設け、純水と各薬液の各々の供給流量から混合処理液の濃度現在値を算出しつつ、混合処理液の濃度現在値を監視するように構成してもよい。

【００８２】また、上記第１、第２実施例やその変形例では、混合処理液の濃度現在値と、薬液供給流量操作信号や純水供給流量操作信号などの処理液供給流量操作信号とに基づき、異常発生を検知するようにしているが、混合処理液の濃度現在値のみを監視して異常発生を検知するようにしてもよい。

【００８３】上記各実施例や各変形例では、混合処理液における溶媒となる処理液に純水を用いる例を紹介したが、溶媒として純水以外の処理液を使用して混合処理液を混合する装置にも本発明は同様に適用することができる。

【００８４】その他、基板処理装置の全体的な構成は、上記第１、第２実施例やその変形例に限定されることなく、複数種類の処理液をフィードバック制御によって混合する機能を備えた基板処理装置に対して本発明は同様に適用することができる。

【００８５】

【発明の効果】以上の説明から明らかなように、請求項１に記載の発明によれば、濃度監視手段からの混合処理液の濃度現在値が混合処理液の所定の濃度許容範囲から外れたか否かに基づいて部品の故障などの異常が発生したことを検知して所定の異常処理を行うので、異常を速やかに検知して適宜の異常処理を速やかに実行することができ、基板の処理不良を未然に防止することができ、装置の信頼性を向上させることができる。

【００８６】請求項２に記載の発明によれば、制御手段から処理液供給流量調節手段に与えられる処理液供給流量操作信号の現在値をさらに監視し、この処理液供給流量操作信号の現在値が処理液供給流量操作信号の所定の変動許容範囲から外れた否かの情報も考慮して異常発生を判定するので、処理液供給流量操作信号も考慮して部品の故障などの異常の発生をより確実に検知することが

できる。

【００８７】請求項３に記載の発明によれば、異常処理として、混合部への少なくとも一部の処理液の供給を停止する処理を含むので、濃度目標値から外れた濃度の混合処理液による基板の表面処理を停止することができ、基板の処理不良を未然に防止することができ、また、無駄な処理液の使用をなくすこともできる。

【００８８】請求項４に記載の発明によれば、混合処理液に複数枚の基板を浸漬して各基板の表面処理を行う処理槽を基板処理部に備えたバッチ式の基板処理装置であって、混合部へ供給する複数種類の処理液が純水と１種類以上の薬液である場合の異常処理として、異常処理手段は、異常検知手段によって異常発生が検知されると薬液の供給を停止し、純水のみを供給するので、処理槽内の混合処理液に浸漬されている複数枚の基板への異常濃度の混合処理液による悪影響を防止することができる。

【００８９】請求項５に記載の発明によれば、異常処理手段は、異常検知手段によって異常発生が検知されると警報を発するので、異常発生を作業者はいち早く知ることができ、復旧作業を速やかに行うことができる。

【図面の簡単な説明】

【図１】本発明の第１実施例に係る基板処理装置の全体構成を示す図である。

【図２】第１実施例装置の制御系の構成を示すブロック図である。

【図３】異常発生の判定に用いる混合処理液の濃度許容範囲を示す図である。

【図４】異常発生の判定に用いる処理液供給流量操作信＊号の変動許容範囲を示す図である。

【図５】第１実施例の異常検知動作などを説明するための図である。

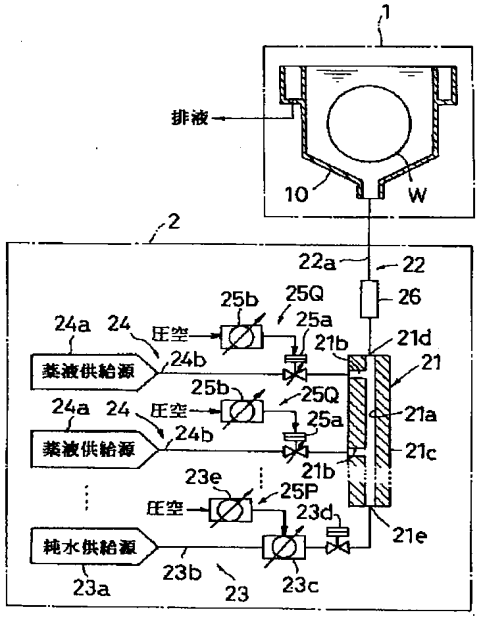
【図６】本発明の第２実施例装置の全体構成を示す図である。

【図７】第２実施例装置の制御系の構成を示すブロック図である。

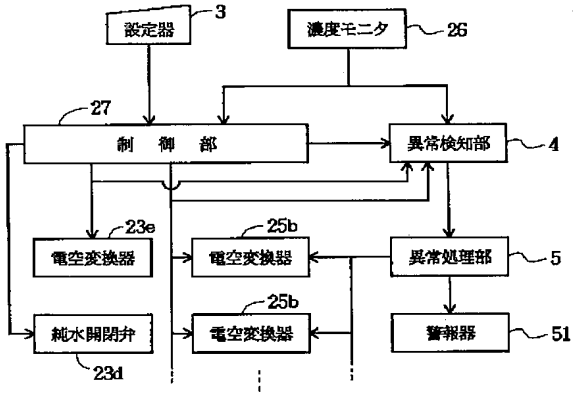
【符号の説明】

１：基板処理部
２：混合処理液供給部
４：異常検知部
５：異常処理部
１０：処理槽
２１：混合部
２２、３３：混合処理液供給系
２３：純水供給系
２４、３４：薬液供給系
２５Ｐ：純水供給流量調節機構
２５Ｑ：薬液供給流量調節機構
２６：濃度モニタ
２７、３０：制御部
３１：混合貯留タンク
３４ｃ：ポンプ
５１：警報器
Ｗ：基板
ＤＷ：濃度許容範囲
ＣＳＷ：変動許容範囲

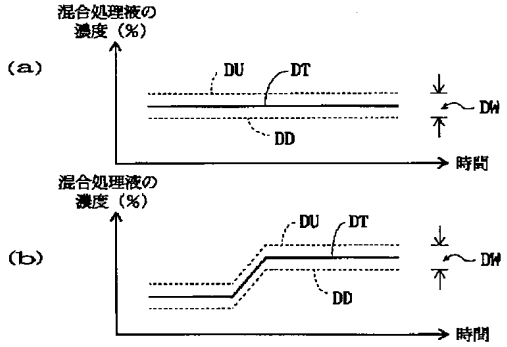
【図１】



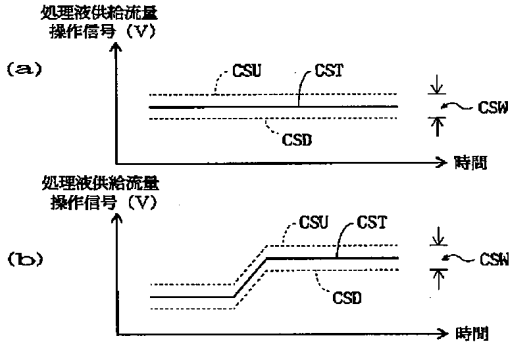
【図２】



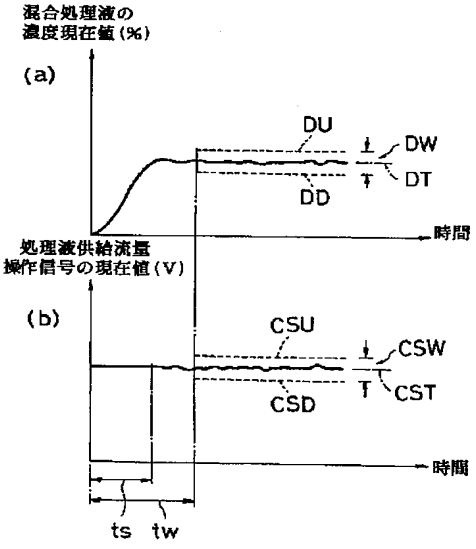
【図３】


混合処理液の
濃度（%）
(a)
DU
DT
DW
DD
時間
混合処理液の
濃度（%）
(b)
DU
DT
DW
DD
時間

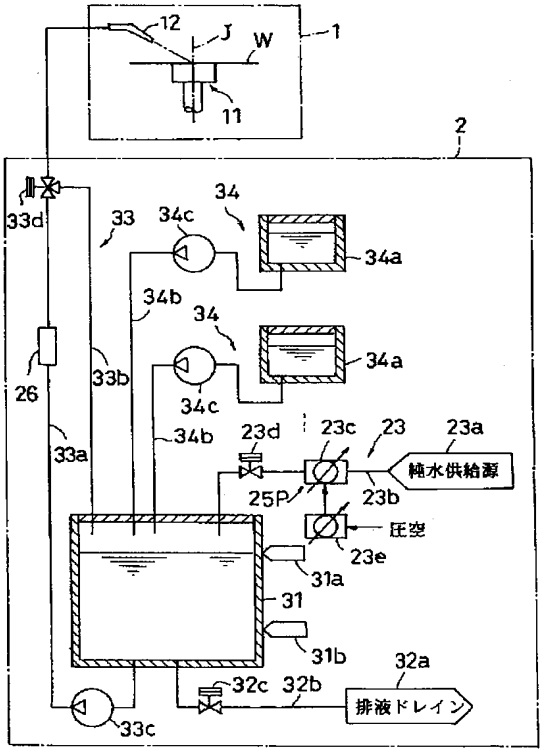
【図４】


処理液供給流量
操作信号（V）
(a)
CSU
CST
CSW
CSD
時間
処理液供給流量
操作信号（V）
(b)
CSU
CST
CSW
CSD
時間

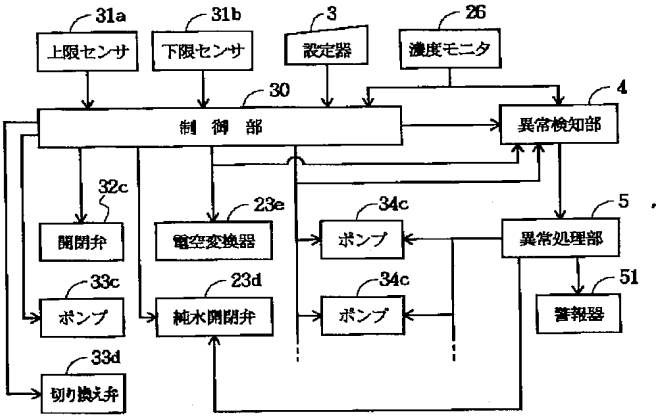
【図５】


混合処理液の
濃度現在値（%）
(a)
DU
DW
DT
DD
時間
処理液供給流量
操作信号の現在値（V）
(b)
CSU
CSW
CST
CSD
時間
ts
tw

【図６】


12
J
W
1
11
2
33d
33
34c
34
34a
34b
34
34a
26
33b
34c
34b
23d
23c
23
23a
33a
純水供給源
25P
23b
圧空
23e
31a
31
31b
32a
32c
32b
排液ドレイン
33c

【図７】



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